THE

MINING MAGAZINE:

DEVOTED TO

Mines, Mining Operations, Metallurgy, &c., &c.

EDITED AND CONDUCTED BY

WILLIAM J. TENNEY,

AIDED BY

STEPHEN P. LEEDS.

VOLUME FIVE.

FROM JULY TO DECEMBER, 1855.

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VOL. V.—JULY, 1855.—No. I.

ART. I.—THE KINGSTON COAL MINES, PEORIA COUNTY, ILLINOIS.—BY CHARLES S. RICHARDSON, MINING ENGINEER.*

THE GREAT FAULT.

Now perhaps it may appear somewhat anomalous, if I say this is no "fault" at all; but what I mean is, that in mining phraseology, the term "fault" is commonly applied inconsiderately to every sudden break or change that cuts out the continuity of the coal; properly speaking, a true "fault" is the protrusion of a mass of rock, foreign to the strata in which the coal is embedded; such as porphyry, greenstone, trap, basalt, and such rocks, said to be of igneous origin. These usually run in direct lines across the country. In the northern coal fields of England they are called win-dikes—from win, or whynstone. In Cornwall, elvan dikes; or, when in a north and south direction, and having a silicious and sparry appearance, are called cross courses. In copper and tin mines, they have a tendency to throw the lode or vein out of their original course; it is then called a heave; or the lode is said to be heaved; and it often causes much perplexity and expense to find it again. In the coal measures the same thing occurs, but the effect is produced vertically—the seam is broken asunder, and one part is thrown up and the other down—at times one part remains in situ, while the other is depressed. Occasionally the "fault" is divided into two parts, and carries a narrow piece of the seam down, leaving the main body in its original level position. This latter phenomena is not often caused by a stone "fault," but by what we term a "throw," or slip-dike. The points of disjuncture are nothing more than a thin vein of clay, or as it is termed in Cornwall, with lead and copper mines, a "flucan and slide." Figure 3, represents one of those "slip-dike faults." An internal convulsion has at some period caused a parallel fracture across the strata, and the piece thus separated from the other, has

* Continued from page 886, vol. iv., June, No. 6.

slipped, or been forced down. Various theories have from time to time been adduced, to account for this unconformity of strata, but that which probably has become most popular among geological writers is, that the interior of our earth is in a dense gaseous state; that condensation is progressive; and the shrinking consequent on a diminution of bulk causes the down-throw. I hold similar views myself in abstract, of this matter, but the case here in point, I account for somewhat differently. I hold the effect produced is adducible to the mechanical powers of nature alone; that the internal gases become surcharged like those of our external atmosphere with electric fluid, ignite and explode. This explosion, by its immense expansibility, shatters the strata above, causing fissures up to its very surface. The gases by explosion become condensed, and the result is, a vacuum is formed. The equilibrium between the internal and external surfaces now having been destroyed, atmospheric pressure equal to 14.7 lbs. to the square inch comes into play, and acting upon the upper surface of the strata, as steam would on the piston of a condensing engine, the parts weakened by the recent fracture gradually give way—hence the down-throw.

Now the "fault" in this upper mine, which, had it been any thing like either of those I have described, would have been a serious drawback to the economical working of the banks. But it is nothing more than what the quarrymen in the south of England chalk pits call "dirt banks." Its thickness, where driven through in the first left-hand headway course, is 32 yards. It is composed entirely of terrestrial matter, brown earth, alluvial clay, plants, roots, leaves, pieces of boughs and bark of trees, land, and fresh water shells. These are not fossiliform but in a natural state, scarcely being yet thoroughly decayed. The mass is soft, and the drift requires timbering to keep it open. No winze has been sunk—rise made—or level driven on its course. Therefore its continuity, dip, or bearing is unknown. If we take its apparent bearing from the line it crosses the headway course, it would be nearly north and south. I am of opinion it is nothing more than a valley, or ravine washed out of the strata, and filled with mud, &c. On the receding of the waters at the close of the tertiary formation, it probably was open for many hundred years, and became gradually filled up by the decaying vegetation of the woods washed into it by the rains; the freshness of the leaves and roots are in favor of such a conclusion. It has no effect whatever on the coal seam, more than having washed out the coal in its vicinity, and caused horseback for eight or ten yards, on either side; the seam continues its regular course, after passing through it. I have frequently seen similar things in the "cretaceous" formation in England, the only difference being they are filled in with sand, gravel, and clay.

Figure 4,* gives the appearance of one of those dirt banks as seen at Maidstone in Kent, Merstrum in Sussex, and Guildford in Surrey in England. These I have often closely examined, and I must pronounce the "fault" in this mine, as we have called it, nothing more than one of those dirt banks; that it is quite local, and does not approach even the second, or lower bank seam of coal. If any doubt on this matter should occur, I would refer you to a good authority, Mr. Mathias Dunn, a highly respectable mining engineer of Durham, England. In reporting on a coal district near Newcastle, he says: "We have met with a 'dirt bank.' It begins at Harborhouse, near Durham, passes Chester-le-street, down the Ravensworth valley, and through the Ouston Collieries; in its course all the upper seams are denuded, but the lower ones are unaffected. At St. Lawrence, near Newcastle, a dirt bank is found, 20 fathoms (120 feet) deep, and is much below the bed of the river Tyne. This shows it is much older than the valley through which the river flows, but here it is composed of sand and gravel."

The coal of this seam is of a light open nature, shiny, very bituminous, kindles very quickly and burns with a strong flame. It gives but little clinker with an open grate; is a most excellent gas-making coal. It is much esteemed by the steamboat firemen, on account of its quick flaming properties. Its combustion is perfect, the ash left being all reduced to dust. There not being any steam boiler at work on the mine, at the time of my survey, I had no opportunity of testing its evaporative power, but I should think it rather low; probably not more than 650; being 1 lb. of coal to 6½ of water. But when reduced to coke, its powers would be very much increased in proportion; the quantity in whole coal and pillar on the estate of this seam, is estimated 5,495,430 tons. From experiments I have tried, I find its

Specific gravity is,	1,216
A cubic foot weighs	76 lbs.
Do. in a marketable form	52 lbs.
Bulk per ton in stowage,	38½ cubic feet.

Cost of raising and delivering this coal at the river is something like the following amount by the 1,000 tons, of 2,000 lbs.† to the ton; but this quantity must be returned weekly, and that for 48 weeks through the year, otherwise the profit cannot be maintained, for the expenses will be nearly the same whether there is 20 or 48 thousand tons returned.

* See Map in last numr of Magazine.
† The Ohio Ton is only 2,000 lbs.

VALUE.

By 1,000 tons, or 25,000 bushels, at 7 cents,		$1,750 00

RETURNING COST.

To opening headways and main drifts,	$20 00	
Furnace men, overmen, packmen, smith,	"	
Hammerman, carpenter and odd man,	60 00	
Proportion of costs in shafts and dead ground,	10 00	
Cutting and removing horseback,	125 00	
Cutting 1,000 tons of coal at 2 1-2 cents per bushel,	625 00	
Hauling out of the mine, at 028, } 4 1-2 cts. per ton, Hauling to the river, at 017, }	45 00	
Hauling out 200 tons waste,	6 00	
Timber, iron, castings, oil, grease, &c.,	30 00	
Landing, stacking, screening, and surfacemen,	50 00	
Officers, Company's expenses, agents' sale commissions, &c., 10 per cent. on net proceeds,	175 00	
Depreciation 5 per cent.,	87 50	
Casualties, losses, miscellaneous expenses,	41 50	1,275 00
Leaving a net profit of		$475 00
Or equivalent to 27 1-7 per cent.		

The above calculations are based on the following data; that

The coal weighs in the bank 76 lb. per cubic foot.
A cubic yard, " " 2052 lbs. " "
A superficial yard of the seam, 2736 lbs. " "
1,000 tons, 730·66 yards square.
A pieces of seam 27·03 yards square, 1,000 tons.
A bushel of coal net, 80 lbs.

The waste is not taken into account, not being paid for by the coal hewer; that this quantity be returned weekly throughout the year, that the system of mining operations be conducted on the principle I have laid down, or some other equal in scientific and modern arrangement. The item for hauling appears to be very low; but from an account given me by John Day, who has the management of this department, I obtain the following statistics. That a well-fed mule costs 1 dollar per week, and the boy to drive it, 4 1-2 dollars per week; that they will haul 20 trains of 4 wagons per day from any part of the mine, when the trains are in good order; each wagon contains 10 bushels, thus making 800 bushels or 32 tons per day; this then is only .028 per ton. Secondly, that a horse and man will run down to the river 18 trains, of two wagons each, per day; each wagon holds 50 bushels, being 1,800 bushels, or 72 tons; the cost of the horse is 2 dollars, and the man 6 dollars, equal to 8 dollars per week, or .0172 per ton, thus showing the entire cost of hauling from the bank to the river is only 4 1-2 cents per ton. I may say, however, that he gives me a much larger quantity than the above, but as he does not take Saturday afternoons and Saint Mondays nto account, which in miners' time forms a considerable item. in

the year's total, I have commuted it to the above as about correct; if, therefore, it can be done at the price here stated by the system hitherto adopted, by a little modification in the tramways and wagons, hereafter to be proposed, the cost can still be reduced 25 per cent. I think you will be somewhat inclined to say, on reading this part of my report, that my figures look very nice on paper, and all very feasible as drawn out in detail, but can such results be realized in practice? I say, most confidently, Yes—if you work the mines and export their produce in the manner I shall direct you. In this winning, I must beg to draw your attention to the pillars standing in the old roads. There are thousands of tons of fine coal, which has been opened up at a cost of thousands of dollars, lying dead or being destroyed by the crush of roof; in a short time this will be buried up and lost. I am aware that the opinion prevalent at Kingston and elsewhere is, that there is an abundance of better coal, and much more easily gotten, and cheaper; such notions may be all very well for a lessee, whose term of lease is limited, or of short duration; it pays him well to pick the eyes out of a mine; but here the freehold is the Company's, and the case is quite a different one. What is lost in the early working is just so much money deducted from the real value of the estate; and the time will come when this coal, which is now looked upon as next to useless, will become of very considerable value; beside, the partial working of a fine seam of coal is not only wasteful, but is bad in practice, and not minerlike. I would advise these pillar workings to be immediately commenced, and what is not good enough for the market should be made into coke. There are also many places in the horsebacks where a very large quantity of good coal may be selected; but this work cannot be done by miners at $40 per month wages; it must be done by "coal pickers," boys employed for that purpose at about 40 cents a day; they would return many thousand dollars worth of coal from the old workings by this means. It will be said there are many difficulties to encounter in introducing any new system of working; and that the colliers having been so long accustomed to work by the bushel, could not be induced to work any other way. I am fully aware of all the difficulties that stand in the way, and there are none but what may be easily surmounted. I do not want to cut down wages; I should like to see every miner get his $40 per month; it makes no difference to him how he works, whether it is by the cubic yard or the bushel, providing his monthly stipend is not diminished; but it makes a wonderful difference to the Company in their yearly balance sheet, whether they have paid 2 1-2 cents per bushel or about 1 1-2 cents, which, in my opinion, is all that a bushel of coal ought to cost from this upper seam.

THE LOWER BANK, OR SECOND SEAM.

This seam lies 62 feet 9 inches below the first or upper seam just described, and 45 feet 6 inches above the river. It is approached by a main drift 286 yards in length; the first part, for 344 feet, is an open cutting, about one half being secured by a timbered retaining wall; the remaining portion, or 513 feet, is close driven and very strongly timbered. At the end of this a ventilating shaft is sunk on to the floor of the seam, being 24 feet from the surface and near the outcrop. Beneath this is an adit drain, or level course, constructed of planking, that takes the water from the mine; the whole extent, driven into the seam, which is due north, is 178 yards; the seam has an inclination on the rise or northward of 1 in the 100, or 5.49 feet in 534; and a dip north-westerly at this spot 1 in 400, or 3 inches in 100 feet. It is not yet driven up under the upper workings. The entrance is a good piece of work, although it would have been much better had it been made wide enough for a double line of rails, and been constructed of brickwork: the cost would have been but a very little more. The ventilation is conducted through a small upcast shaft, which at surface is connected with a surface incline drift, timbered and covered over, which ascends to the top of the bluff; here a stack or chimney is erected about 15 feet high; there is also an arch turned over here for a ventilating furnace, but I should think it never would be adapted, being entirely misplaced. There is a small basket furnace at the bottom of the shaft, which is in its proper place, and where the working furnace must be built to enable the present operations to be carried on; but eventually a new upcast shaft must be sunk from surface, as the one now used is much too small, and also too near the outcrop of the coal. I have measured very carefully the quantity of air now in circulation through the mine, and find it to be as follows:

BY NATURAL VENTILATION.

Velocity of air between the first left hand headway course and the upcast shaft,	2.127	feet	per	second.
Through the entire return air course....	1.70	"	"	"
Mean velocity..........................	1.9185	"	"	"

Equal in quantity to 3,985 cubic feet per minute.

The cause of the great difference in the velocities was through imperfect stoppings between the intake and the returns. These I had partially secured and then set the basket furnace to work, and got up a good heat, when the result obtained was:

BY ARTIFICIAL VENTILATION.

From first headway course to shaft.................	2.68	feet	per	second.
Through the entire return air course...............	2.242	"	"	"
Giving a mean velocity of.........................	2.486	"	"	"

Equal in quantity to 3,800 cubic feet per minute.

The average sectional area of the return air course is not over 26 superficial feet, and as it requires 300 cubic feet of pure air per minute for each working collier to maintain the working in a safe and healthy state, it shows the present amount of ventilation is totally inefficient.

This seam gives an average thickness of four feet three inches, and is one solid mass of coal. There is no regular cleet, but like the upper seam has fine partings, right angled with the plane of deposition, which are intersected by others longitudinally of the same character. It breaks with an irregular fracture quite cubical. In its strata cleavage it shows the vegetable fossil very distinctly; in working it makes but little slack; it is cut for three cents per bushel, or seventy-five per ton. In burning, it ignites freely, gives out an intense heat, withstands a strong draft without crumbling, burns to a perfect dust ash without cinder, and but little clinker. For domestic purposes, it is excellent, and makes a good average quality steam coal. It makes a very bright, clear coke, particularly from the slack, for which it is most admirably adapted. From experiments I have tried, I find its

Specific gravity	1.325
A cubic foot weighs	83 lbs.
Broken, or merchantable	55 lbs.
Ash in an open grate	7 per cent.
Clinker	none
Ash in a close stove	4 per cent.
Clinker in a close stove	2 " "
Bulk in stowage per ton	36.36 cubic feet.

Not having any apparatus to test its evaporative qualities, I cannot speak for certain, but judging from a similar coal that has been thoroughly analyzed, I give the following as an approximation to its properties.

Evaporative power 8.50

COMPONENT PARTS.

Water,	0,850
Volatile matter, (ether)	18,150
Earthy matter,	7,000
Fixed carbon,	73,900
	100,000 parts.

Commercially considered this may be classed as a standard quality coal. As it stands in the seam, it really looks beautiful; not a break, fault, slide, throw, trouble, slip or horseback is to be seen in any part of the winning; the only thing of the kind is a few thin veins or fissures near the outcrop, filled with clay from the upper loose soil; these occur throughout the entire range of the bluffs, and are caused by the subsidence of the edges of the seam: they in no way affect the quantity, quality or

working of the coal, and as such are totally unworthy of notice. In estimating the cost of working the coal from this seam, it will differ from that of the upper one; the seam is much more compact, consequently harder to break. It will be wrought by the "stall and pillar" system, as shown in the drawings. I will take, as in the former instance, 1,000 tons as a weekly produce.

1,000 tons is	25,000 bushels.
A cubic foot weighs	88 lbs.
630 yards of seam is	1,000 tons.
1,000 tons is produced from a piece . . .	25$\frac{1}{16}$ yards square.
A cubic yard weighs	2,214 lbs.
A yard of the seam	3,175 lbs.

VALUE.

By 1,000 tons of screened coal at 8 cents per bushel, .	$2,000 00

RETURNING COST.

To opening headways, main drifts and returns,	$94,000	
Furnacemen, timberman, overman, carpenters, smiths, and 2 laborers, ...	70,00	
In new upcast shaft and dead work, .	25,00	
Iron roads throughout the mine, wear and tear of rolling stock, renewals, &c., . .	100,90	
Timber, iron, castings, oil, grease, &c., .	60,00	
Cutting 1,000 tons at 3 cents per bushel, .	750,00	
Hauling from the workings to the river, 8 cts.	80,00	
Landing, screening, stocking, trimming, &c., .	50,00	
Officers, Company's expenses, commissions on sales, &c., 10 per cent. on gross returns, .	200,00	
Depreciation, or an equivalent to a royalty of one twentieth, or five per cent., ...	100,00	
Casualties, losses, accidents, and miscellaneous,	21,00	1,500 00
Leaving a net profit of . . . . . . Or equivalent to 25 per cent.		$500 00

Now by adding together the weekly profit of the two workings, we have the sum of $975, or for a working year of forty-eight weeks, $46,800; but, 4,000 tons a week can be returned just as easily as 2,000, while the ratio of working expenses would be greatly diminished. Say that the weekly profit shall be made up to $2,000, or 96,000 per annum on a return of 192,000. This will give, after allowing for redemption of first purchase (called here depreciation), a dividend of 19$\frac{1}{5}$ per cent. on a paid-up capital of half a million. Now this relates to the mining department alone, but there are many other sources of revenue derivable from the expenditure of such a capital. In compiling an estimate, therefore, of the annual profit, we must take in the rental, and sales of lands and buildings, the earnings of the steamboats and barges, the extra profit made on the sale of coal when exported to a distant market, the manufacture of coke from the waste of

the mine, interest on reserve fund, and unemployed floating capital, banker's balances, &c. Take all these into consideration, and I have not the least hesitation in saying that a fair dividend of 25 per cent. may easily be made after allowing an ample amount as a reserve fund. Therefore, with this splendid income in view, and with a little exertion at command, with a certain anticipation that every year increases the surface value of the property, that the progressive development of the mineral resources of this part of the great valley of the Illinois, not only becomes one of individual advantage, but, commercially considered, tending to the realization of national prosperity; I must say that the Kingston Coal Company ought to congratulate themselves in being the possessors of such a field of wealth.

MINING OPERATIONS.

By a reference to the plan of the underground workings of the upper mine, it will at once be perceived that at the onset there was no systematic plan laid down, or arrangements made for future or extensive workings. The same thing occurs in all the openings of the coal seams throughout the country as far as I have been; where the seam was most easily wrought, or where no horseback was found, there the miner drove on, regardless of either ventilation or economy: the former is the vital principle on which not only the health and safety of the miner depends, but ultimately the profits of the proprietors. Unfortunately, in most new countries, this is too frequently the case. Practical men, I am sorry to say, are very apt to sneer, and often speak contemptuously of the judgment and works of others; but if we view the thing in a right light, we should put a charitable construction on the matter; and if we reflect a little, we must know that all colliery operations in this State form quite a new business; its early stages were often conducted by persons who never saw a coal mine in their lives; in other instances its details were left to the judgment of working miners. This class of men, however skilful they may be in driving an end, or hewing coal in a fair bank face, are totally incapable of conducting the *modus operandi* of a large work like a colliery, whose term of working may probably extend over a period of fifty or a hundred years, and involve or regulate the fortunes of several generations of men. They know very well that the men cannot work long in a foul atmosphere; but how to get fresh air in, and take the foul air out, in quantities proportionate with the extent of the workings, is a thing they generally have a very faint idea of. It is a common remark when errors have been discovered, Why did not the owners call in the assistance of a practical mining engineer? Such remarks are perfectly absurd; for, even if the owners in the early development of their mineral properties could afford to pay this class

of men for their advice, they are not always to be obtained: in fact, the little acquaintance I have of the mining community in this country, although I have travelled about a good deal the past two years, leads me to believe they are very few indeed in number even at the present time. Therefore I say that the present proprietors of the Kingston Collieries must be lenient in their censure on all the errors of commission and omission perpetrated by the former owners of the property, and place the affair in the position of a matter of course.

DRAWING NO. 2,

Is a plan of the upper mine as it now exists, with the system to be pursued in its future workings. It is divided into twelve panels or districts, an arrangement that admits of many important advantages in point of economy, ventilation and dispatch in working out the coal, while, at the same time, not so expensive as the old-fashioned way. Those parts tinted in a buff color are the present and old workings; that tinted in red or pink represents the new or proposed extensions; the "arrows" denote the course of the ventilation.

The opening into the main or centre bank is commenced at the outcrop, near the confluence of two ravines, one running nearly north-east, and the other north-west. The main drift is extended four hundred and fifty yards, in nearly a (magnetic) north direction. The variation of the needle here is 7° 30 min. The workings are called here entries, cross entries and rooms; but as such a nomenclature would be totally unintelligible to the general reader of mining reports, I shall adopt such terms as are commonly applied by the English miner—for a fuller description of which I would refer you to a little work published by the proprietors of the English Mining Journal, entitled "A Synopsis of Mining Terms," price 37 1-2 cents: and may be had, I should think, at Mining Magazine, 98 Broadway, New York. Beneath the main drift is a level course that drains the water for three hundred and thirty yards from the mouth of the drift. It is much too shallow, as the water on the first reverse dip of the seam stands from ten to fourteen inches deep in the drift, and requires to be continually bailed or pumped out. This drift is the main intake and travelling road. It is not more than five feet, and in some places not over four and a half feet high, which is at least a foot too low. It is constructed for a single line of wooden rails, which is wrong in principle, as there always must be a great delay in the egress of loaded and ingress of empty wagons. A short siding at the entrance is provided; but this is inefficient; its sectional area does not amount to more on an average than twenty-six feet, which is further reduced as an intake air course by the obstruction presented of wagons standing in or passing to and from the mine,

the consequence of which is that it is inadequate to meet the requirements requisite to ventilate the works towards the working end. There are no regular return air courses at all. The first headway course is driven in a north-west direction three hundred and fifty yards. It is very irregular and crooked, which was done, I presume, to avoid horseback, which it has passed through in several places. The roof is very bad near the "fault," and requires immediate attention; the water also stands over the rails in several places. From this headway the stalls are driven out in every conceivable direction. In passing through the "fault," the timbering is in very good preservation; beyond the "fault," it enters into a piece of more modern work, and which is the only part of the whole bank that can claim any pretensions to minerlike work. It has a new upcast shaft, and a return air course. It was done under the direction of your present manager, Mr. John McLeod, and, as seen on the plan, stands out in bold relief from the tortuous configurations of every other part of the work. In the whole coal workings at this part of the bank the coal is good, and extends to within a short distance of the "fault," where, as in every other part of the mine, the pressure is removed, and expansion taking place in a lateral direction, has let down the water, and horseback is the result. There are in this headway, like that of the main drift, many pillars of excellent coal fast giving way by the crush. Whether they will all pay to take out or not, remains to be proved by experiment. I am of opinion most of them will, if the proper method is adopted; but in this kind of work none other than men accustomed to pillar working should be employed. The roof in many places, from long exposure, is very bad. The slate is quite decomposed, and crumbles down around the props and cap pieces. A timid workman is of no use whatever in this branch of mining; a good timberman is indispensable, as he will know how to secure the roads and air courses on the sinking of the roof, and at the same time save his props from being buried in the goaf behind. There are no inflammable gases in this seam, therefore the only provision for ventilation is that required for the working faces of the pillars. These are all in No. 4 panel, which is bounded on the west by the "fault," and east by the main drift.

THE SECOND LEFT HEADWAY.

This is in No. 4 panel, and is driven about one hundred yards. Much good coal was got at the first part of the workings; but the end is in horseback, and the roof in many places has fallen down and filled up the road.

THE THIRD LEFT HEADWAY

Bounds No. 4 panel on the north, and is driven two hundred yards, terminating in horseback near the "fault." It is to be re-

gretted this level was not extended twenty yards further, as it would have determined the direction of the "fault," which, in the plan, is placed in an assumed position. Near the end is a stall-way course, driven to ventilate this part, and forms a junction with the first left. In this was an air shaft, but it is now fallen in. The whole is in a very bad condition, and may be considered the worst part of the mine. Near this old shaft is one of the strongest horsebacks, similar to that shown in fig. 2. By its side is a pillar of five-feet coal, perhaps as good, if not better, than any other in the mine; but it was difficult of access, and required care in approaching it. Being fully aware that differences of opinion will exist relative to these old pillar workings, I felt a desire to ascertain how they would turn out. I therefore applied to Mr. McLeod, who kindly let me have two miners on whom dependence could be placed, and I commenced an experimental pillar working. I chose this as being the most difficult and dangerous part of the mine. After securing the road, the pillar was cut away entirely up to the slide of the horseback; the result of which was, I found the coal of most excellent quality, even in the horseback itself. About twenty wagon loads were removed, and the remainder now stands in the pillar, open for inspection. Of course this does not prove all the old pillars will pay to remove. The experiment was on a small scale, and only the work of two days; but the trial satisfied me that where the coal is not too much crushed, and the roads are clear, pillars may be removed at a profit.

THE FIRST RIGHT-HAND HEADWAY, NO. 3 PANEL,

Is driven nearly due east about eighty yards. It has been worked in pillar on each side, and terminates in horseback near the outcrop in the eastern ravine. The roof has gone down nearly all over the excavations, and therefore is finished out.

THE SECOND RIGHT HEADWAY, NO 3 PANEL,

Contains some very good pillars. It is nearly parallel to the last-named headway—has been extended eighty-eight yards, terminating in horseback on approaching the ravine.

THE THIRD RIGHT HEADWAY

Bounds No. 8 panel on the north and No. 8 on the south. It has been driven irregularly easterly one hundred and thirty-two yards. Ten yards from the end it encountered a dip of roof; but the miners say it is a "nip," and the rock driven into was excessively hard. I could not get into the end, it being inaccessible. I have my doubts about it. If there was a "nip" in the seam, I should have seen some indications of it before: nevertheless it may be so, such things do occur in shallow seams, and the spaces

are filled in with mill-stone grit, which would accord with the account given of the rock being so hard; but it is of very little consequence, as the pillars remaining on the east side of the main drift are not worth the expense of taking them out.

Nos. 6, 7 and 8 panels have not been opened out more than is shown by the advance of the main drift. The coal is very good there, but shallow horseback occurs all the way along.

No. 1 panel is in the west bank, and has been opened on a short distance, and the pillars worked out as seen by the goaf shown in plan. The coal here is of first-rate quality, with little or no horseback in going to hill. I have here started my first pair of exploring drifts, which will hence be called the first left headway course; to facilitate the ventilation while running in those drifts, a temporary furnace and shallow upcast will be constructed at the entrance, by which means the ends will progress much faster, and be driven cheaper. A large quantity of good coal may be looked for in this direction. South of this point, just below the slack heap, a drift was run into the hill forty yards, entirely in dead ground; the country was yellow clay. Whether the coal has been denuded along this side of the bluff as far up as this, or that the seam has made a rise or dip, has never been ascertained. I am somewhat of opinion there is a rise, and the drift is under the seam. It has been supposed by some that this is the outcrop of the "fault;" but that cannot be, as the deads are not composed of the same material; besides, it would have been intersected in the south side of working in No. 1 panel had such been the case. In the east bank, by the side of the railway, on the opposite side of the valley, five levels have been driven into the bluff on the course of the seam. The coal in places was very good; but the prevalence of horseback rendered the works unprofitable, and they were abandoned. I do not consider them worth being resumed, as the east bank will eventually be worked by a new and distinct main drift, commenced about two hundred yards below the main street of the town, which said drift will be continued north to the intersection of the right-hand main headway's course of the new extended workings.

THE EXTENSION.

It will become obvious to those who make themselves acquainted with this upper mine, that the system hitherto pursued, was more calculated to entail a loss, than gain a profit to the owners. By the plan you will perceive there are seven!!! shafts sunk; when one, properly located, would have been sufficient to work the entire steam throughout the estate. The stall and pillar system, as pursued here, is not, when the roof is weak, and so much waste to contend with by horseback, etc., the most judicious mode of carrying out the workings; neither is the bushel mode

of valuing labor a good one, only for the men. I would much rather see the work carried out by the cubic yard, and coal pickers employed to separate the coal. I have, therefore, arranged my plans for the future working to be conducted under what is known as the improved "Longwall system," a method becoming very popular in many collieries in England. It consists in carrying the entire seam of coal away at one working, and allowing the roof to fall in as the works progress. I consider it by far the best system in a shallow winning, and particularly, when the roof is soft and falls freely, provided there is no water overhead, or buildings to damage by the subsidence of the strata, with the fall of roof, which in this instance there is not. I have in addition to the common custom adopted the plan of panelling, whereby the division of labor is more conveniently arranged; the different qualities of coal selected; the supervision more easily managed; the ventilation made more constant, efficient, and permanent; the yield of round coal greater, there being less waste in consequence of less hewing in narrow work, and finally the cost of production greatly reduced. On the other hand, although the "Longwall system" possesses so many advantages in working a seam like this in the upper bank, it would be entirely out of character in adopting it in certain parts of the lower seams; but for me to give you a detailed account of the operations of each system and their relative merits, with where and how applicable, would be lengthening this report beyond what is desirable, useful, or necessary.

Suffice it then to say, that after a careful survey of the mine and examination into its qualifications, I recommend the new "Longwall system" for this bank, being thoroughly and firmly convinced it is the best plan to be pursued. The panels are set out 200 yards square, and if 20 per cent. is allowed for horseback and waste, they each contain—

In gross quantity	54,720 tons, or 1,368,000 bushels.
Or net	43,775 tons, or 1,094,400 bushels.
The seam contains	6,621 tons to the acre
Its entire quantity is . .	5,495,430 tons,
Marketable value at 7 cents	9,617,002 dollars.

THE LOWER BANK OR SECOND SEAM.

Lies, as before stated, sixty-two feet nine inches below the one above described, and 137 feet below the highest point on the bluffs; there is consequently a superincumbent weight on each square foot of the seam of 8 9-10 tons; the crushing weight of a foot cube of this coal is thirty-two tons; its resistance to fracture by direct vertical pressure may be taken at two thirds, or 21 1-3 tons per superficial foot, showing that two thirds and three-

tenths of the coal may be taken away without endangering the quality of the coal left in pillar by the crush.

DRAWING NO. 3

Shows the extent of the present workings, which are colored bluff; the main drift which is driven due north, is only constructed for a single line of rails; this must be cut away seven feet, and made wide enough for a double track; the present upcast shaft, which is only four feet diameter, may answer for a time with a furnace built at the bottom, and the uptake drift properly secured; the plan of extended workings are colored red, and are set out in panels, to be worked by one new upcast shaft, ten feet diameter, on the "stall and pillar" system; the lobby of the shaft is made of sufficient capacity to construct three working furnaces, so that one, or all three may be used at the same time, just as the state of ventilation may require to be increased or diminished; the main drift, and main right and left-hand headway courses are to be twelve feet wide; the centre between the two lines of rails to be securely and permanently propped; these panels are also set out two hundred yards square, and contain each—

In gross quantity . . .	68,500 tons, or 1,587,500 bushels,
The seam measures . . .	7,733¼ tons to the acre,
The entire quantity is . .	7,594,297 tons,
Marketable value at 8 cents . .	15,188,594 dollars.

The quantity of coal in this seam alone will require 300 working miners thirty-six years to work it out, allowing each man fifteen tons a week for 48 weeks in the year.

No. 1, or first panel, is represented as being entirely worked out, with packs built between the outside pillars to maintain the air course.

No. 2, is shown as worked into pillar, all the stalls being completed, and is ready for pillar working, when a demand for a large quantity of coal may be required on a short notice.

No. 3, is a panel where the pillar workings have been commenced; the mode of ventilation is shown by the directions of the arrows.

No. 4, is a panel in stall working, or whole coal; the ventilation is effected from the first right headway course, and down the stallway course; this latter pair of drifts are only extended as fast as the stall workings require ventilation: should there be any deficiency of air, any of the stalls at the side of the headway may be used as an intake, and the return thrown into the crossgate and again up the first return stallway course.

No. 5, shows a panel partly formed, with some stalls commenced at each of the lowest corners.

No. 6, a panel completed ready for working; the large pillar shown in the centre, is to be left permanently to support the new engine shaft of the lower winnings. A footway will be made into it to communicate with the upper bank and surface.

No. 7, is a similar panel; the permanent pillar left, is to support the new upcast shaft, the lobby and its furnaces.

No. 8, shows a panel in course of forming with whole coal, and pillar workings going on at the same time, but it is a course I do not approve of; I introduced it here to show the system to be pursued in the ventilation, should the proprietors have cause to adopt such a plan of working. My opinion is, to carry out a colliery work properly, and to the best advantage, all the airways and travelling roads should be completed around the panels before the stalls are commenced, then the panel may be operated upon simultaneously on either side, and the work carried on in a workmanlike manner.

Nos. 9, 10, 11 and 12—are the advance panels, and are the same in every respect with those above described. It must be understood that the works here set out are not to be carried forward immediately, as it will take several years before the coal can be even reached in the 12th panel.

THE ENGINE AND UPCAST SHAFT FOR THE LOWER WINNINGS.

The section of the engine shaft seen in Plan No. 3, is intended to show the manner in which the coal is drawn from below and delivered to the railway trucks at the surface. The engine proposed being used for this purpose, is the 150 horse-power horizontal engine, now on board the steamer "Kingston." It is not the best plan that can be devised, but as the company have got this engine on hand, it will answer the purpose for some considerable time, or until the workings below require additional power; the buildings are constructed of sufficient dimensions to admit a larger engine. The winding apparatus consists of 2·4 feet flat rope drums, with heavy fly wheels. The speed in the shaft is 300 feet per minute, which, allowing for the time of starting and stopping, will give 3-4 of a minute for the transit of the cradle and wagon. The banksman can very easily shift the wagon loaded with coal, and replace an empty one on the cradle in 3-4 of a minute, or on an average, 30 wagons per hour. Each wagon contains half a ton. The engine is supposed to work 20 hours per day, and would thus throw up 1,800 tons of coal per week. The screens and tip are self-acting. The coal is delivered direct into the railway trucks, and no further handling is needed until the coal is delivered in the market. The slack or screenings, when the bins are full, will be run down to the coke ovens, which will be erected near the wharf on the river. The first lift of pit work will be 12 inches with an 11-inch working barrel; the

sinking lift, a 9 inch pump with 8 inch workings. The main rod will not continue below the first lift until the sump is down 22 fathoms, where a plat or lobby will be cut and a cistern fixed, and the bucket rod offset for the sump lift on the reverse side as seen above. The travelling cradles run in timber guide rods, and are sustained in their places, when stationary, by self-acting catch pins or spring bolts secured to the shaft collar. They will each be provided with "the miner's safety apparatus," which will prevent the possibility of the cradle being drawn over the pit head pulley, through any neglect of the engine driver; or, in the event of the rope breaking, the wagon and its contents being precipitated to the bottom of the shaft. No drawing shafts in collieries, and particularly when the miners descend and ascend from their work, should be without these simple contrivances. Their first cost is quite trifling, while the safety of life is insured. Deplorable accidents are continually taking place through the non-application of this apparatus; and to such an alarming extent in England, that the Parliament have passed a law making it compulsory, on the part of colliery owners, to adopt them, or in the event of accident, imposing heavy penalties for such neglect. The ropes to be used are 6 inches wide by one inch strand, capable of sustaining a load of 6 tons. These flat ropes wear much better than round ones, and although attended with a little more expense as first cost, are far the cheapest in the end.

The transverse section of the shaft in Plan No. 2, shows the capstan and shears—elevation of front of engine house, and front view of pit work. For further particulars see detail working drawings.

The new upcast shaft not shown in the large plans, will be sunk from the top of the bluff, where a 30 feet stack will be erected, so as to command an uninterrupted current of air from off the prairies. It will be 12 feet in diameter, and 44 fathoms, or 264 feet deep. It will be lined with fire brick for the first 60 feet above the 3d coal seam, and secured with ordinary brickwork in all places where the rock is of a soft or friable nature. At the bottom will be constructed 3 furnaces and a spacious lobby; over these furnaces, if necessary, gas drifts will be carried up 30 feet above the crown, so that in the event of the production of much fire-damp (carburetted hydrogen gas), it will pass up the shaft without coming in contact with the furnace, and thus lessen the liability of explosion. By this arrangement, from 70 to 100,000 cubic feet of pure air will be thrown into and traverse the entire workings, giving a sufficient ventilation for 300 miners.

THE BORE.

Prior to the commencement of sinking the shafts, a bore will have to be put down to ascertain the nature of the strata; this is

essential on two accounts; first, to determine the exact position of the seam, and secondly, the quantity of water to be encountered in the sinking—the first will determine the cost of the undertaking, and the latter the necessary engine pumping power required. I do not apprehend the cutting of any strata of silt, or running sand above the 3d seam of coal; but I should look for it about 100 fathoms down if the greenstone is met with; however, the bore will decide all these matters, therefore no comment is needed thereon. But although running silt may not be cut, yet it cannot be expected that this shaft is going to be sunk in dry rock; there will be seams of water and probably strong ones too, a few feet below the level of the Illinois River, between the sandy limestone and the shales; these will have to be stopped by the usual process of wedging curb tubbing; the shaft when complete must be perfectly free from water, otherwise the rarefaction will be injured and the proper amount of ventilation not obtained,—hotter the air in the upcast shaft, quicker is the velocity of the air below, and consequently its volume increased.

ROADS AND RAILS.

The system of using clumsy wooden rails, is one bad in principle and expensive in practice; the friction on the wheel faces by the soft rough edges of the rails, causes a direct loss of 20 per cent. on the haulage power; they are continually out of order, they decay and wear away very fast, are expensive to lay, and worse to maintain. I would advise you to do away entirely with them in the lower workings, and introduce the plain, simple, edge bar rail; these are made of common bar iron 2½x⅝. In the main drifts, and other travelling roads, they can have small light cast chairs, which are not expensive either in first cost or in fixing, and the rails after being in use ten years are worth about one third their first cost for old metal, having earned in that time three times their value in the saving of horse power and haulers' wages. The sketch, figure 5, shows the manner in which the rail lays in the cast iron chairs.

The trams used in the stalls and exploring drifts can be used without chairs; all that is required is to have the sleepers made of hard wood, such as hickory, oak, beach, hard maple, etc., of which an abundance is found on the estate; the rail is inserted in a slot, cut about 1½ inch deep into the face of the sleeper, and secured by either a wood or iron key (see figure 6).

There are many little appliances I would recommend, simple in themselves, but of great practical value in the works, such as Jack-props; hollow column props; stack props; rolleyway bends; switches; air-doors; close brattices; air crossings; level courses; regulators; screen tips; furnace drifts; cooking ovens, etc., etc.; but they must come in with the working specification,

as their details will swell this report so as to render it tedious to the reader, it having already gone far beyond what I originally intended.

PLANT—ROLLING STOCK, ETC., ETC.

This part of the works lies entirely in the hands, and its economy and well working to the skill and judgment of the manager; many improvements may be made in the wagons, and the mode of working them; as well as in the screens and disposal of the waste and slack. But a system has been adapted, which is said does very well, and a change is unnecessary for the time being; I shall, therefore, let this pass over, but before concluding this part, I must strongly persuade you to have proper carpenters' and smiths' shops erected adjoining the saw-mill, with shafting connected with the engine; in the carpenter's shop, fix a circular saw bench with a travelling bed; by this machine all the slabs and tops will be converted into useful purposes, which are now nearly wasted; there should be a boring and a mortising machine, with a rough circular planer also attached in the smith-shop; a punching and drilling machine, with a strong screw-cutting lathe, and grindstone, should be erected: with these tools, every thing wanted on the mine could be done; the cost of them is quite trifling when compared with the advantages they possess; the saving in labor and materials would be enormous, and I fully believe, with the large amount of work necessary to be done immediately on the property, that the first amount of cost would more than be saved in one year's labor.

STEAMBOATS AND BARGES.

The steamboat "Kingston" is now quite old and nearly worn out. She never was fit for the purpose, as she draws nearly 5 feet of water when in steaming trim. No boat drawing more than 20 inches is fit for the waters of the Illinois; even boats with that shallow draught, at times cannot clear the numerous shoals and bars that in low water time obstruct the navigation between here and the Mississippi. The "Kingston" is a side-wheel boat, 150 ft. long, 21 ft. beam between her guards, hold 5 feet 4 in. deep above the kelson; 20 feet paddle wheels, 7 feet 9 in. wide with 18 inch floats; has one horizontal engine, 7 feet stroke, 19½ inch cylinder, with expansive gear; works at 125 lbs. of steam cut off at 1-3 the stroke; makes 18 effective strokes per. minute; without slip her speed would be 12 miles per hour; she makes 5 miles, I am told, with 4 loaded barges in tow. I suppose her engine is called 198 horse power, or 132 working expansively. There are two boilers, 26 ft. long, 3 ft. 6 in. diameter, with two return smoke flues through each, 2 funnels and a heating apparatus. The boilers are very leaky, and in what I call bad

condition; but in this country it is not considered so; I say a boiler of this kind is not safe over 40 lb. of steam, or when new over 100 lb. There are 6 barges, 3 of them quite new; they are excellent craft, well made and in good order; their tonnage is computed at 300 tons each; I consider 300 ton barges much too large and cumbersome for this trade; they should not exceed 100 tons, and only draw 18 inches of water when loaded; these would be much better to handle. If you intend to raise 4,000 tons per week from the mines, 1,000 tons may be sent away by railway, as the line within 12 months will be completed to Kingston, and 3,000 tons by water. To do this you will require 40 barges of 100 tons each, and two steam tugs of shallow draught, say not exceeding 18 or 20 inches; they can be constructed to draw only 14 inches. A 150 horse power tug boat will run down to St. Louis (200 miles) in 36 hours, towing light barges or flats containing 1,000 tons of coal, and return with 10 empty barges in about 40 hours; or make an average of two trips per week in summer time; but as other markets beside St. Louis will require to be supplied, a second steam tug is wanted; there will always then be 12 barges unloading, 12 on the way, 12 loading, and 4 on the slip under repair or lying by as spare ones, or to be used for short distances. These boats must be provided with washboards and battenings, or else tarpauling weatherings; the latter are best, then the barges may be loaded down to the gunwale with safety; by this arrangement the tugs will always be under steam and no delays take place. The river, I find, is not frozen up generally for more than a month or 6 weeks in winter, therefore if proper vessels be provided, a nearly uninterrupted trade may safely be carried on throughout the year.

THE COAL TRADE.

This is a matter I have not gone into so fully as that immediately connected with the mines; but from inquiry I have ascertained that 4,000 tons a week may readily be sold without any extra exertions on the part of the managers. Chicago alone, in 1853, consumed 36,000 tons, and this winter coal was so scarce that it sold for 25 cents per bushel, or $6 25 per ton, the cost of freight from the mines to Chicago being $1 25 per ton. The company should have a depot there, it would be a profitable investment. The following statistics may give an approximate view of the coal trade as now open.

WEEKLY DEMAND.

Chicago,	500	Tons.
Pekin, Peoria and Lacelle,	100	"
Ottawa, Juliet, and towns on that line of road,	200	"
Rock Island, and villages on the line,	200	"

Burlington, Aquaka, and villages on that line,	200	Tons.
Mouth of the Illinois,	1,000	"
Mouth of the Missouri,	1,200	"
St. Louis,	1,500	"
Illinois river towns,	500	"
River steamers, loaded at the wharf,	400	"
Local trade and miscellaneous orders,	100	"
Tons,	5,400	"

This is quite a minimum view of the trade, when the cross country lines are completed to connect with the Central Illinois Line one way and the Mississippi towns on the other, with those numerous and flourishing villages springing up in every direction on the prairies, and in places totally destitute of fuel. We can form at this time no conception of what the trade eventually will be; but from this it will readily be seen no difficulty exists of disposing of 4,000 tons of coal per week.

THE LOWER MEASURES.

This is a matter that in a short time must arouse your attention, it is one of such profound importance, and one that, when proved, will disclose such startling facts relative to the mineral wealth of the Kingston estate as to astonish the whole country. There is now apparently a large tract of land without coal; this land, in my valuation, I have put down at only $5 per acre. I feel quite a reluctancy in expressing my opinion of what lies below. If I were to figure out the value of the coal seams throughout the estate that lie below the second seam now working, most persons would feel inclined to doubt, and many to say I was trying to impose on their credulity. What would they say if they were told that beneath those bogs or swamps there were seams of rich bituminous coal, at easily workable depths, containing 15,681 tons to the acre!!! whose marketable value is $31,362 per acre when raised? Incredulous! they exclaim. Nevertheless, astounding as such an assertion would be, I say the time is not far distant when the public will know that such a quantity does not amount to any thing like one half the entirety.

The depth at which the third seam lies below the second cannot be stated with any positive degree of certainty; but that it is there every practical mining engineer, who carefully examines the strata below the 2d seam, will admit. Every mining man entertains his own reasons, why it is there, and where it is. You will want to know, of course, some of those reasons; I will therefore give an abstract of what may be considered the aggregate of prevailing opinions. That the lowermost seam of coal lies immediately on either the primary, transition,* or the early secondary formations; that this is the base on which reposes the carboniferous formation which follows, and in which nearly all the coal

seams lie. These may be covered over by the permian group, the trias, oolite and lias, as at Bristol in England; by the cretaceous, as in Belgium; and the tertiary, as at Newcastle and other coal fields in England, and elsewhere. But when a coal seam is once cut, and the strata below it is of the carboniferous or coal-bearing description, not one man in fifty but will say there are other seams below, because, to use a common expression, "you are not yet down on the shelf," meaning the rock on which the lowermost seam is supposed to repose. Now, in the Kingston 2d seam, the coal-bearing strata has scarcely began to develope itself, and the lower we descend the indications increase in promise; therefore, in common with every one who has made himself acquainted with these facts, I say there are several seams below. I have here used very plain and simple language to show the reason why there are other seams; any body could have told the same. But the exact depth, or near about, that the next seam lies, is quite another matter; it must necessarily for a time be taken as mere conjecture. I have come to a conclusion in my own mind on this point, but I must beg to be excused from explaining the way I have arrived at it, and for the following reasons: that I have been studying from actual examination the various systems, formations or strata of England, Ireland, Cornwall, North and South Wales, and, the past two years, many parts of America. I am quite unaided by the assistance or opinions of others. I have been endeavoring to form a standard scale; whether I shall succeed or not remains to be proved. The task is an arduous one, and will require many years of research to accomplish; yet I often realize, on a small scale, the result of my calculations. If I ever fully succeed, I shall give the fruits of my labors to the world; but not until I do shall I bother thinking men's heads with what may, by the "unscientific," be called an abortive theory. From my analogical calculations then, of the Kingston coal field, I am led to conclude, that although there may be a thin seam of coal, and probably ironstone, about 60 feet deep, that the next workable seam lies about 125 feet below the 2d or present lowest seam, and that it will be found from 5 to 7 feet thick, and of a quality superior to that now being produced from any part of the present mines.

THE WESTERN MINE.

This is a small work, opened in a ravine at the western side of the estate. It was done at a time when a difficulty existed between the Butty, who had a contract for the upper bank, and the original proprietors. The site was not a very judicious selection, but it answered I presume the object they had in view. It is driven into the upper seam; there is a great quantity of horseback, being so near the outcrop. The coal is of good quality where the

seam is found, but it will not pay for working unless the main drift is extended some 100 yards farther in. It is situated above a mile from the river depot, consequently the coals have to be carted away. There are two drifts, the right-hand one is extended sixty-six yards, in a north-east direction, and several stalls are turned off both left and right, but the end is fallen in. There is too much horseback to be worth working. The left-hand drift is also in about sixty-six yards. A good deal of coal has been taken out here; its bearing is 65° north-west; the water stands deep in towards the end, being on the dip of the seam. This working has proved what the coal is at the confines of the estate this way; and Jones's working, about a mile from here north, has proved what it is there. So far, these explorations have been useful, but not for any other purpose; I need therefore say nothing further about them.

REMARKS.—CONCLUSION.

Before closing this report, I must beg leave to express my thanks for the many obligations I am under to your manager, Mr. John McLeod, and also to Mr. Hutchinson; every assistance that could be afforded were most willingly tendered by both those gentlemen. It often happens to persons of my profession, when called on to examine and report on the works of others, that difficulties are thrown in their way, or things are attempted to be shown up in a better light than they really are worthy of; also defects known to exist are carefully hidden from view; but at Kingston every thing was quite the reverse, and most happy am I to say that not a thing I wanted done, a question answered, or information obtained, but what was most readily acceded to. The large amount of useful and well arranged work, executed since the property has been under the direction of Mr. McLeod, is such as to call upon me to notice it, and I would fain expatiate thereon; but being so favorably impressed with this gentleman's general management, I think it would look like flattery in me to do so, and I know his good sense will appreciate my reasons in being silent. Neither must I pass over your underground foreman or overman, Mr. Sugget; he is a man of experience, and was very diligent always in assisting me, particularly in describing those parts of the upper mine that were inaccessible. I hope to see him carry out the workings in the way—I know he can—if he likes. I now conclude with a few remarks on myself, trusting they will not be taken as given from motives of egotism. I have spent three months on the estate, in which time I have made every possible examination useful to the object of my mission. My estimates are compiled with much labor and care; my drawings are rough, but they are accurate and practical. Those of the extended workings are what we consider in England embracing the most

modern improvements, particularly as relates to the ventilation: they require a specification and working detail drawings. In my calculations of the two coal seams, I fear no contradiction. I hold no pretensions to, or profess to be, a geologist; still I entertain some feeble ideas of practical geology—those given in this report you will take for just what they are worth. I am highly impressed with the value of the property, and can foresee extraordinary results in the working, if conducted with capital, skill, perseverance and patience. It is the first colliery I have had the honor to survey in this country. It is the finest I ever saw in my life at so shallow a depth, and I never would wish for a better. In my description of it, I have been as plain and concise as the nature of the case admits. I know full well I have not done it justice, and I shall esteem it a very great pleasure to see some one hereafter more able than myself dilate on its real merits.

Art. II.—REMAKS ON THE CHANGES WHICH TAKE PLACE IN THE STRUCTURE AND COMPOSITION OF MINERAL VEINS NEAR THE SURFACE, WITH PARTICULAR REFERENCE TO THE EAST TENNESSEE COPPER MINES.—By J. D. Whitney. *

The decomposition of metalliferous lodes in their superficial portions, is a matter often noticed and generally expected by the miner, and there is nothing anomalous in this respect in the East Tennessee Copper region. The commonly observed facts are these: the predominating metalliferous ores which are wrought in mines, especially of silver, copper and lead, are sulphurets, sulphur being the usual mineralizer, although arsenic and antimony are not unfrequently found in connection with sulphur in combination with these metals. These ores are sometimes scattered irregularly through the gangue in fine particles, and sometimes arranged in nearly parallel bands or plates, which are separated from each other by belts of barren veinstone. This is the normal condition of the veins at a considerable depth, and some of them retain their original appearance, and remain chemically and mechanically unchanged up to the very surface. In most metalliferous lodes, however, it is found that the ores have undergone decomposition down to a certain depth, which rarely exceeds 300 feet, and generally falls between 50 and 100 feet. This decomposition is perhaps more common and more strongly marked in cupriferous lodes than in those of the other metals, although some argentiferous veins in South America exhibit it on a grand scale. The predominating ores of copper are the variegated ore and cop-

* Silliman's Journal.

per pyrites, both of which are combinations of sulphur with copper and iron, and their presence in the veins beneath is indicated on the surface by an outcrop of what the Cornish miners call *gossan*, a term which has been generally adopted wherever the English language is spoken. This is a hydrated peroxide of iron, usually much mixed with silicious and earthy matter, and having a somewhat open and porous structure. Associated with this ferruginous mass, the oxidized combinations of copper are often found occurring, at no great distance from the surface; among these, the carbonate and silicates are the most common, the phosphate and arseniate less so. The oxides themselves and the native metal are among the products of decomposition. Sometimes these oxidized ores are very abundant in the upper part of a cupriferous lode, and are wrought with large profits, owing to their richness and the softness of the ground, and the consequent facility in mining. In other localities, nearly all the copper has disappeared from the upper portion of the vein, and only traces of these ores are found with the gossan. On sinking down into such decomposed veins, a gradual change is found to take place in their character: the oxidized ores are replaced by the sulphurets; the ferruginous aspect of the lode disappears; the gangue becomes more solid, and the walls are better defined.

These changes in the upper portion of the sulphuret-bearing lodes, are usually conceived to be the result of the action of air and water introduced from the surface, and penetrating gradually downwards. Through their joint influence the sulphuret of copper and iron is gradually decomposed, and while the latter metal remains behind in the form of an impure hydrous oxide, or gossan, the copper is also converted into an oxide, and may remain in that state, or combine with the sulphuric acid furnished by the oxidation of the sulphur with the original ore, or with any other acid which may chance to be present, thus giving rise to the numerous beautiful ores, most of which contain water, which are so common in the higher portion of cupriferous veins. The nature of the combinations resulting from any such decomposition, and their relative quantity must, of course, depend on the quantity and quality of the ore originally in the lode, the proportion and kind of veinstone, and probably still more on chemical and perhaps electric agencies, the precise mode of action of which is as yet but imperfectly understood.

In the Polk County mines, these changes are displayed on a grand scale. The metalliferous veins which belong to the segregated class, are very wide, and the decomposition has been very complete, so that the outcrop of gossan is very marked, and in some places occupies a width of 100 feet on the surface, consisting of large angular blocks of ferruginous rock piled up along the line of the vein. On sinking into this mass of ferruginous matter it is found to be tolerably soft, but at the same time so compact that

excavations in it need but little timbering. If the shaft is commenced on the summit of a hill, it will be necessary to penetrate a hundred feet, perhaps, before any change in the nature of the vein is perceived. In the valleys the distance required for this purpose is much less. The depth at which the gossan terminates is nearly coincident with the water-level, or the point where, in sinking, water is found in considerable quantity. Here a layer or bed of copper ore is met with of very irregular dimensions, in some places occupying large bunches or pockets of many cubic yards in content, and in others forming only a thin stratum. This deposit of ore is quite as variable in composition as it is in dimensions. Its color is usually quite dark, and when rich in copper, almost black. It is evidently a mechanical mixture of black oxide of copper with sulphurets of iron and copper, sulphate of copper, oxide of iron, silicious matter, and some manganese. The per-centage yield of copper is usually low; but the purest portions contain from twenty to thirty per cent. of metal. This deposit of black ore is the object of exploration in the mines, and the only source, thus far, from which copper has been obtained in any quantity worthy of notice.

Beneath the black ore is the undecomposed portion of the vein, showing, in two or three points, where I was able to see it at the time of my visit (1853), a hard quartzose gangue with particles of copper pyrites scattered through it, and associated with a considerably larger quantity of iron pyrites. There seems no reason to suppose that the ore which originally existed in the upper part of the vein, from whose decomposition the black ore was derived, was any different in nature from that found below, although there may have been bunches of it considerably richer in copper. The deposit of black ore is insignificant in dimensions, compared with the mass of gossan which overlies it, and when we consider that a large portion of the copper which was once disseminated through perhaps a hundred feet of overlying veinstone is now concentrated into the thickness of perhaps two or three feet, on an average, it will be seen that it is not necessary to suppose that the whole of that portion of the vein which is above the bed of black ore, "doubtless once consisted of yellow sulphuret of copper," as Mr. Tuomey supposes to have been the case. Certainly there is no reason to believe that the black ore is a sulphuret of copper, altered by heat. Apart from the consideration that it is not such a product, or mixture of products, as would be produced by any igneous action on copper pyrites, we can conceive of no way in which the effect of increased temperature could be limited to the upper portion of the vein, so that that only should undergo decomposition. That the changes in question are exclusively the result of a humid process, can, as it seems to me, be hardly doubted. The concentration of the black ore in one stratum seems to have been due to the percolation of the surface water, which was

constantly carrying it downwards to the point where it was stopped by the solid portion of the vein.

That the subject of the decomposition of veins, is one which is thoroughly understood, should by no means be inferred from the preceding remarks: there is, on the contrary, much in these phenomena which has not, as yet, been satisfactorily explained. We know, indeed, that the changes of the sulphurets with oxidized combinations do occur, for we see them taking place under our own eyes, through the joint action of air and water holding carbonic acid in solution; but why in some mining districts the metalliferous veins should be thus affected, while in others no change whatever has occurred, is less easily understood. Burat has called attention to this circumstance, and cited some instances in which the sulphurets remain entirely unoxidized up to the very surface. Thus the cupriferous veins of Mouzaia in Algiers project out from the surface like walls, being more permanent than the adjacent rock, and the first blow of the hammer reveals the pyritiferous ore in its natural state. The same thing may be observed in this country. Throughout the Northern States the pyritiferous lodes remain apparently in their unaltered condition; or, at most, have undergone but little change, and exhibit hardly any indications of gossan. The enclosing rocks are not at all softened or stained with ferruginous matter. As examples of this he would instance the great veins of Shelburne, and Eaton, in New Hampshire; those of Hampshire County in Massachusetts; and the St. Lawrence County mines in New York. In none of these has any marked change taken place near the surface. In one part of the Southampton (Mass.) lode, a few oxidized ores were found when the mine was first opened, but they were small in quantity compared with the mass of the unaltered ore. This state of things is a great drawback on the opening of the New England mines, since the expense of sinking and driving in the hard granite and quartzose rocks is enormous. In North Carolina, South Carolina and Georgia, on the other hand, the gneiss and slates are often found over a great extent of territory completely decomposed and softened, so that they may be excavated with the pick and shovel, down to a depth of fifty or a hundred feet. I have known a shaft sunk in North Carolina in the rock to the depth of sixty feet in one week.

In the veins of that State, the principal, indeed, almost the only one near the surface, is an auriferous gossan resulting from the decomposition of iron pyrites, with which a little copper pyrites occurs intermixed. Of this latter ore, the quality in several instances seems to increase with the depth of the workings. If the veinstone is wholly quartzose, the extent of the decomposition is much less than when it contains feldspathic or slaty portions. Thus in the McCullock mine, in Guildford County, N. C., there is a body of soft ferruginous ores containing a good amount of

gold, which extends downwards more than 100 feet, and parallel and coëxtensive with this auriferous mass, which may be mixed with a shovel, there is a heavy bed of quartz with iron and copper pyrites scattered through it, in which no traces of decomposition can be perceived.

With regard to the East Tennessee veins, the practical question of the most importance is: what kind of ore, and how much of it, is likely to be found in sinking into the undecomposed veins beneath the level of the black ore. This, we believe, can only be determined by actual trial. If in cleaning out the deposit of ore, which lies upon the hard veinstone beneath, there should be bunches of cupriferous ore found, the best of them should be opened by sinking on them, and there can be no satisfactory reason given, based either on analogy or on the appearances of the bodies themselves, why considerable quantities of the yellow ore of copper should not be found within a reasonable depth. Still it is not impossible, that, as these views do not exhibit the characteristics of true fissure veins, they may be found to have been richest near the surface, and not to be capable of being worked with profit in the hard rock.

ART. III.—ON THE MANUFACTURE AND APPLICATION OF VARIOUS PRODUCTS OBTAINED FROM COAL (COAL-GAS EXCEPTED.)* No. 2.—BY PROF. F. CRACE CALVERT, F. C. S., &c.

DISCUSSION.—The Chairman said it now became his duty to invite discussion on the very interesting paper just read, and he was sure all must be pleased with the animation and vigor with which the subject had been brought before them. Mr. Crace Calvert was a bright example of the importance of that happy alliance between England and France which they were all anxious to encourage. Mr. Calvert studied chemistry under the first French chemists, Chevreul and Dumas, and so long did he remain abroad, and so assiduously did he devote himself to his studies, that when he returned to England he had lost his native tongue. He was glad, however, now to find that he had regained the proper use of his own language, and that he still retained all the animation of our neighbors. The subject which Mr. Crace Calvert had brought before them was not only of great practical importance, but of great philosophical interest. When lecturing in this room on the Results of the Exhibition of 1851, he (Dr. Playfair) declared that the great end in modern civilization was

* Continued from page 370, Vol. VI.

to effect an economy of time, or to make the most refuse products conducive to the advantage of manufactures and arts. When coal gas was first introduced into use, it was contended that there was an intolerable quantity of refuse for which no use could be found, but now there was not one particle of that refuse, with the exception of the naphthaline, which was not already of great commercial importance. So important indeed had the waste products become, that many of their manufactures could not get on without the oils and dyes produced from them. Mr. Crace Calvert in alluding to the various products from coal, with the exception of the gases, had divided them into aqueous and tarry, and if he (Dr. Playfair) alluded to them, it was only to call their attention to some points which Mr. Crace Calvert had not noticed. That gentleman had shown them how alum was obtained, and had spoken of it with a fondness as though it were a child of his own, and he had pointed out its importance in dyeing; but whilst dilating on the importance of ammonia in its general applications, he did not tell them that it was from that fetid mass that ladies' smelling bottles were filled, and that they derived sal volatile. Then, again, benzine had a most extraordinary effect in cleaning white kid gloves, as he could testify, and that, too, without leaving that roughness which generally attended the operation. Then with regard to carbolic acid, it was expected to prove a most valuable antiseptic, though it had hitherto not been much employed, excepting in the preservation of wood. Mr. Crace Calvert, in speaking of several of these discoveries, had referred to a certain gentleman in Manchester, but he had too much modesty to tell them that that gentleman was Mr. Calvert himself; and with reference to carboazotic acid, should it prove as valuable a febrifuge as he anticipated, it would stamp Mr. Crace Calvert as one of the greatest benefactors of mankind. He had next referred to naphthaline, the odor of which chemists had not yet been able to get rid of—though it would yet be got rid of, and the substance rendered useful in dyeing. He had also shown them how the refuse of coal might be made useful in the manufacture of solid paraffine and paraffine oil. Paraffine obtained from other sources had been long known as a most useful lubricator, and was originally proposed for the works of chronometers. Paraffine had this advantage—it would not combine with the oxygen of the air, and thus become rancid. Paraffine oil from coal possessed all the advantages of solid paraffine, and was now used almost all over the country for lubricating machinery. The reason why the beautiful paraffine candles they had been shown that evening were not brought extensively into use, was, that the manufacturers of the article had a demand for it in its liquid state beyond what they could meet, and therefore it was not to their advantage to manufacture it into candles. He had only thus run through the principal heads in order to point out the subjects for

discussion, and should now be happy to hear any gentleman upon it.

Mr. Winsor trusted that he might be allowed to express the deep debt of gratitude which they must all owe to Mr. Crace Calvert for the pleasure, entertainment, and information they had derived from his paper that evening. He had had the honor of being a member of the Society of Arts for upwards of thirty years, and being the son of the introducer of gas lamps into England, if not throughout the whole world, he trusted he might be excused for presuming to address them. He certainly had felt somewhat astonished at what he had heard that night. He recollected when Dr. Playfair was lecturing on the Great Exhibition, in alluding to his father, he spoke of the indomitable perseverance of Mr. Winsor, and he now begged to thank him for that testimony to his father's memory. He now wished to call their attention to the evidence given before Parliament in 1809, when the Chartered Gas Company was applying for its Act of Incorporation. In the preamble of their bill it was set forth that the products of coal were gas, pitch, tar, essential oils, and ammoniacal liquor, and they then produced in the House of Commons specimens of those products of which since so much had been made. He now had great pleasure in moving a vote of thanks to Mr. Calvert for the mass of information which he had laid before them, and for having shown them how the various products of coal would benefit the whole country,—as gas had for several years. He should be happy at any time to render any information to the Society on the gradual progress of gas manufacture, and he hoped ere long to embody in a work which he would lay before the public, the history of gas-lighting for half a century, leaving it to the scientific world to determine upon its value.

Mr. Varley seconded the motion, and expressed the great satisfaction with which he had heard the observations relative to extending a knowledge of science amongst the people.

The Chairman said, that before putting the question, he would ask if any gentleman wished to make any observation, and he particularly alluded to Mr. Bethell as having had his invention noticed.

Mr. Bethell said, that it was most difficult to touch the various questions brought before them that evening without occupying several hours of their time. Mr. Crace Calvert had brought the subject before them in a very lucid and talented manner, though he had been obliged to notice very cursorily many points for want of time. The possibility of the preservation of wood by tar oil had struck him whilst seeking for some material to preserve wood for railway sleepers. The stone sleepers originally laid down were found to destroy the carriages very quickly—and it being desirable to use some softer material, wood naturally presented itself. How to preserve it then became a question, and it

was proposed to use solutions of various chemical salts. It was considered that the decay of wood was principally caused by the albuminous nature of the sap, and that if some matter could be obtained to coagulate it, the decay would be stopped. Corrosive sublimate, and sulphate of copper, were therefore tried for this purpose. It was found, however, in practice, that this process was too expensive, and besides, although it prevented the putrefaction of the sap, it had no effect on the fibrous matter of the wood. He then determined to try the oil of tar, and he was induced to do so from finding that the agents used to preserve the Egyptian mummy were of an asphaltic nature—asphaltic oils being collected in great quantities on the Persian Sea, and in different parts of Egypt, where, in consequence of the heat, it exuded through sandy rocks, &c. Finding that this substance was used for making mummies, he considered that what would preserve animal flesh would preserve wood. He, therefore, determined upon using oil of tar, and then came to be considered the mechanical method of making the wood absorb it. He found that where wood had been used perfectly dry it stood uninjured, if protected from the weather, for ages, as was to be seen in the roof of Westminster Abbey; and he determined so to saturate the wood with oil of tar as to render it impervious to water. The result had far exceeded his expectations. A few days ago some sleepers were taken up between Manchester and Crewe, which had been laid down in 1838, in order that they might be replaced by some of a heavier description, when it was found that the old sleepers were perfectly sound, and they were about to be used on parts of the line where there was less traffic. The unprepared sleepers never lasted more than four or five years. A great many improvements in this country were stopped by the prejudice which people had against any thing bearing the smell of gas. For instance, pitch and other products of tar were highly important in ship-building, yet, so prejudiced were the English shipwrights against coal-tar and pitch, that they would only use the tar and pitch from Archangel or Stockholm, though it cost ten times as much as the English. In the Mediterranean the native vessels which were not coppered suffered very severely from the worm, and the Maltese and Sicilians found that the Archangel and Stockholm pitch would not protect them; but with the coal pitch and tar no worm would touch the vessels, and there was, therefore, a great demand for the English pitch and tar in the Mediterranean, the boat-builders of which would readily give more for it than for the vegetable pitch or tar; but there was a prejudice against it in England because it was to be obtained cheaply at our very doors. In fact, all pitch and tar from the mineral kingdom was much better and stronger than that from the vegetable, and much more of a preservative. By the injection of the carbolic acid from tar, mixed

with a little olive oil, into the veins of the body, they might keep anatomical subjects fresh for many weeks, and it would have no effect upon the scalpel, which showed the great power and usefulness of the carbolic acid; and the only reason why it had not been extensively used for the preservation of meat was that the gaseous smell would be more or less retained.

In answer to a question from Mr. Winkworth, Mr. Crace Calvert stated that there could be no doubt that when they wished to disturb the streets, paved as Manchester was, for the gas or water pipes, that as the stones had to be raised by the pick-axe, there was considerable labor required beyond that for removing the ordinary pavement. The reason why it was not more generally used he could only suppose was, that each locality had its own peculiar manner of doing things; but any one who rode over the streets of Manchester could not fail noting how free they were from the jolting and reverberation felt in London and other cities.

The Chairman, in putting the motion, said he could not help remarking how deeply he sympathized with the remarks of Mr. Crace Calvert relative to the popularizing of science; and he might take that opportunity of informing them, that so desirous were the Government to aid in that object that they had prevailed on Dr. Hofman, one of the most eminent chemists of the day, to deliver a course of lectures on chemistry at the School of Mines, for the almost nominal charge of 5s. the course—instead of about £5—and sure he was that it was as little as it could be done for to remunerate the professor at all.

Mr. Crace Calvert returned thanks, and expressed the gratification he felt at what he had just heard from Dr. Playfair, trusting that the same advantages would shortly be extended to Manchester, Birmingham, and other places. Sure he was, if Dr. Playfair had but a few coadjutors as enthusiastic in extending a knowledge of science as himself, it would soon become as popularized as the most earnest lover of science could desire.

Art. IV.—OBSERVATIONS ON THE EXTENT OF THE GOLD REGION OF CALIFORNIA AND OREGON,* &c., &c.—By Wm. P. Blake, Geologist of the U. S. Pacific R. R. Survey in California.

The information contained in the following brief notes, was partly obtained in connection with the government exploration in California for a practicable route for a railroad to the Pacific, and partly during a visit to the mining region, and a residence of

* Silliman's Journal.

several months in San Francisco. The localities and minerals found in the course of the explorations for the government will receive a more extended notice in the report now in preparation.

GOLD.—It is not yet possible to state the boundaries of the great gold-field of California. It has been gradually expanding on the north, west and east with the progress of exploration, until placers have been worked under the snows of the high ridges of the Sierra, and it appears probable that the crest of that great mountain chain is overlaid by the precious dust. On the north and west, new placers of unequalled richness are constantly discovered, and gold is brought from nearly all of the numerous ranges and ridges that trend off from the upper or northern portion of the Sierra Nevada, and traverse nearly the whole breadth of the State and a portion of Oregon, reaching the coast between Cape Mendocino and the Umpqua River in lat. 43° 45′.* The placers are therefore no longer confined to the State of California but extend into Oregon, not only to the Umpqua River, but beyond it, throughout both Oregon and Washington Territories to the parallel of 49°.† Of this northern portion of the gold region there is however but little known, and the latitude of the Umpqua River may be regarded as the northern limit of general mining operations for the present. On the south, the limits of the field have been extended nearly to the Tejon pass at the head of the Tulare valley in lat. 35°. This point is about forty miles south of Kern River where, according to the recent intelligence, the placers are rich and are exciting considerable attention. This river rises in Walker's pass (lat. 35° 39′), and flows westward over a broad area of granitic rocks to the Tulare valley, where it empties into the most southern of the Tulare lakes. South of the head-waters of this river the crest of the Sierra Nevada gradually deflects to the west and the breadth of the exposure of granitic rocks decreases, until at the Tejon, the slopes of the Great Basin and the Tulare valley are only thirteen miles distant. The auriferous slates, (talcose slates,) are not found in the section at the Tejon pass, and this may be considered as the southern limit of the Sierra Nevada gold field.

It is more difficult to determine even approximately the eastern and western boundaries of the auriferous area. The elevated portions of the Sierra having been but slightly explored, its

* It is interesting to observe in this connection that when Prof. J. D. Dana, the geologist of the E. S. Expl. Exp., passed rapidly over the section of country in 1841, he noticed that the rocks gave indications of the presence of gold, and in an article published in this Journal in 1849, he mentions the region as follows: "It is quite probable from indications observed by the writer that gold may be found in many parts of the range of country between the Umpqua and Sacramento."—Am. Jour. Sci., [2] xii. 262.

† This statement is made on the authority (verbal communication) of Dr. John Evans, geologist of Oregon and Washington Territories.

eastern limits are not yet defined. Its western margin along the Sacramento and San Joaquin is better known, but is exceedingly irregular. The greatest expansion of the field from east to west is probably in the north-western part of the State where gold is found from Mt. Shasta to Gold Bluffs on the coast south of the Klamath (lat. 41° 30′)—a distance of 110 miles.

Farther south on the Yuba River the breadth in the direction of the general course of the river is not less than fifty miles. This is believed to be its average width for a long distance southward or to the vicinity of the San Joaquin, beyond which, its limits become more and more contracted to its final termination at the end of the Sierra Nevada. The average breadth of the field for its entire length may be said to be not less than fifty miles.

If, for the convenience of making an approximate estimate of the area of that portion of the auriferous belt that is now partly explored and worked, we assume the latitude of the mouth of the Umpqua River (43° 45′) as the northern margin, we find that placers are worked over nearly nine degrees of latitude; or if the distance be measured in the direction of the trend of the field, the region is over 700 miles in length. Multiplying this length by the average breadth (50 miles), we have as the result, an area of 35,000 square miles. If, instead of the parallel of 43° 45′ the parallel of 49° is regarded as the northern limit of the gold region, it extends over fourteen degrees of latitude, or over about 1,100 miles. According to this estimate a very considerable portion of the field lies to the northward of the state line of California (lat. 42°) and is within Oregon and Washington Territories. There is evidently no natural separation or boundary in the auriferous region of California and Oregon, and it must therefore be regarded as one continuous field.

It is desirable for convenience of description and reference that the whole gold region should be known by a suitable name, and that it should be separated into convenient geographical divisions.* Our knowledge, however, of the region north of the California line (or north of the Umpqua) is yet so limited that it is useless to propose any division beyond the general one of *Oregon Mines* and *Washington Mines*, which will naturally be adopted as explorations extend over those territories.

In California the gold district extends through, and in some cases includes the following counties: Klamath, Trinity, Hum-

* It is desirable that a name for the gold field should conform to that which may be given to the great mountain chain of which the Sierra Nevada forms but a part. The writer is engaged in preparing a description of the mountain chains of California, with a view to their classification and nomenclature. The appellation *Columbian Chain* has been suggested as a suitable one for the great line of elevation referred to.

boldt, Siskyon, Shasta, Bute, Sierra, Yuba, Nevada, Placer, El Dorado, Sacramento, Calaveras, Tuolumne, Mariposa and Tulare. The counties of Tuolumne, Mariposa, and Tulare are each large enough to form several of the size of Placer and El Dorado.

It is already the custom in California to speak of the mining region south of Stockton as the *Southern mines:* this name passed into general use before the placers in the north-western corner of the State were discovered. In 1854 a map of the *Northern* and *Middle mines* was published in San Francisco, but no boundaries for these divisions were given.

The division of the California district into three great and nearly equal areas with the above appellations, is certainly desirable, and an excellent natural boundary between the northern and middle divisions is found in the upper Sacramento and Pitt Rivers; while the Calaveras River is perhaps the best that can be selected as the dividing line between the middle and southern. I therefore suggest that these names be adopted for the areas within the boundaries that I have given.

The Northern mines and those in Oregon are now very productive and important: the gold is considered to be superior in its quality and generally commands a high price among the purchasers. The facilities for access and transportation to them from the Sacramento valley and from the coast, are better than in the Southern mines. A large portion of the supplies is sent to the interior towns from Crescent City and other ports on the coast. Mining operations are conducted at various points on the beach, from famous Gold Bluffs—about 30 miles south of Crescent City—to the Umpqua River. The most important localities are in the vicinity of Port Orford between Gold River (Rogue River) and Croose Bay, a distance of 80 miles. Gold is found over the whole distance in the beach-sand from the surface to a depth of six feet or more; it is in very small and thin scales and separates from the black sand with difficulty. Platinum and the associate metals, iridosmine, &c., are found with this gold in large quantity; and as they cannot be separated from the gold by washing, its value in the market is considerably lessened—indeed it is sometimes difficult to make a sale of the mixed metals in San Francisco.

The black sand is found in enormous quantity; it is very deep, and is irregularly stratified by the tides. It is undoubtedly stirred to a considerable depth by the surf during storms, and this is shown to be the case by the fact that the richness of claims that have been worked is renewed during high tides or a storm.

Placers of San Fernando and San Francisquito—Santa Barbara? Co.—This locality of gold has hitherto received but little attention, although it was known to the Californians long before the gold of the Sacramento valley was discovered. These placers are on the southern flank of the mountains that have a nearly

east and west trend from Point Conception to San Bernardino and from the southern boundary of the Great Basin and the Tulare valley.

These placers are about fifty miles south-east of the Tejon pass and eighty south of the Kern River placers; they were worked near the ranch of San Francisquito by Mexicans in 1840, and were abandoned when the reports of the great discoveries at the north reached them in 1849.

Talcose slates apparently auriferous and resembling those of North Carolina, occur in the pass of San Francisquito and are traversed by quartz veins. It is reported that veins of auriferous quartz in that vicinity were worked simultaneously with the placers.

An occasional excitement is produced by glowing reports from this locality, and according to recent accounts new placers have been found in the vicinity of Los Angeles. Although we are not yet aware of the extent of these placers, it may be safely asserted that they will not compare favorably in area or richness with those of the Sierra Nevada. They are comparatively local in their extent, but the region is worthy of a careful examination.

Gold of the Great Basin—Tulare Co.—Armagosa Mines.—A vein of auriferous quartz traverses one of the granite ridges of the Great Basin near the Mormon trail to Salt Lake and about 170 miles from Los Angeles. The vein has been prospected and attempts to work it have been made by several companies organized in San Francisco, but it is now abandoned.

The gold is found in wire-like filaments ramifying through quartz and carbonate of lime. I have an interesting specimen in which a string of gold traverses a rhombohedron of carbonate of lime and protrudes from its opposite faces. The form was reduced to a rhombohedron by cleavage.

The occurrence of gold in place, in one of the ridges of the Great Basin, so far removed from the Sierra Nevada gold field, is an important fact, and renders it more than probable that extensive placers will be found throughout its length and breadth.

Colorado River—San Diego Co.—It has been frequently reported that gold exists along the Colorado River not far from Camp Yuma at the mouth of the Gila. I could not obtain satisfactory evidence of the truth of this statement; but if it does occur, it is far from water and vegetation, and prospectors are obliged to carry the earth they wish to test many miles before water enough to wash it out can be found.

On the western slope of the mountains between San Diego and the desert, there are good indications of gold at several points west of Santa Isabel and near the travelled road. The region is worthy the attention of prospectors.

Coast Mountains, Santa Cruz Range.—According to J. B.

Trask,* gold has been found in the Coast mountains, in the counties of Monterey, Santa Clara and San Luis Obispo.

AURIFEROUS QUARTZ.—Quartz veins are found in great numbers traversing the slates, the granite and greenstone rocks of various portions of the Sierra Nevada gold field; but comparatively few of them have been worked to any extent. Among those that produce the most interesting specimens, the following may be mentioned.

Nevada Co., Lafayette and Helvetia Mine.—Beautiful plates and angular masses of gold are found imbedded in snow-white quartz in this mine. They are frequently intimately associated with brilliant crystals of white iron pyrites, and in other specimens the gold is entirely isolated from the sulphurets and is surrounded on all sides by the compact opaque quartz. Specimens of this character are sought after by jewellers, and are cut and polished for ornamental purposes. An immense quantity of "quartz-gold" is ground and polished in San Francisco into shapes suitable for rings, bracelets, cane-heads and the like. Specimens for this purpose are mostly obtained from the placers, but some of the purest and most brilliant are procured from this mine.

Nevada Co., Grass Valley—Gold Hill Mine.—Extraordinary specimens of gold in large smooth plates have been found in one of the veins of this mine. They traverse a semi-crystalline quartz, and in some specimens the gold is crystalline and is implanted among the ends of the quartz crystals.

Specimens that I obtained, have many interesting mineralogical peculiarities and appear to throw light upon the phenomena of the deposition of the metal.

Nevada Co., Grass Valley—Ophir Hill.—The Empire Company are working a quartz vein at this place, which bears a large amount of white iron pyrites, remarkable for the quantity of gold it contains. If a specimen of the pyrites which does not appear to contain gold, is placed in a strong nitric acid so that the sulphuret is partly dissolved, gold becomes visible in many points, showing that it exists in a form favorable for collection.

Tuolumne Co., Marble Springs (Merced River).—An interesting quartz vein at this locality bears plates of gold, iron pyrites, galena and zinc blende. These minerals are abundantly disseminated in a compact gangue of white quartz, and form beautiful specimens for cabinets.

Placer Co., Volcanoville.—This place is opposite Forest Hill on the middle Fork of the American river, and is noted as the locality of one or more very rich quartz veins. They occur traversing slates in connection with erupted rocks, and contain iron

* Report on the Geology of the Coast Mountains. Sacramento. Senate Doc., No. 9. Sess. of 1854. p. 58.

pyrites and free gold, disseminated in irregular masses. Specimens of unusual value and weight have been broken out of parts of one of the veins, and gold can now be found ramifying through the quartz where it has been uncovered and brought to view by the removal of the earth from the top of the vein.

Placer Co., Georgetown—Mamaluke Hill.—A quartz vein of unusual richness occurs at this place traversing the talcose slates and apparently conforms to the bedding. It is narrow and much decomposed, the quartz being cellular and friable, and is highly charged with irregular filaments and ragged masses of gold. The decomposition and discoloration of the vein and the adjoining slates rendered it so obscure that it remained unnoticed while the claim was worked as a placer mine. I had the satisfaction of pointing out its true character and washing out the first prospect, which amounted to several dollars. Within a few weeks after this discovery, the owners of the claim were taking out 274 ounces a week, sometimes finding four ounces in a pan. The last accounts that I have received state, that sixty-five thousand dollars worth of gold had been obtained—all from an ordinary mining shaft fifty feet deep, and without the aid of machinery.

CRYSTALLINE GOLD.—Good crystallizations of gold are comparatively rare in California. A hundred pounds of coarse placer gold may be carefully examined without finding a single well-formed crystal. This may partly result from the custom among the miners of reserving any peculiar or remarkable specimens of small size for breast-pins or for preservation as curiosities.

Placer Co., Forest Hill.—Interesting octahedral crystals have been found in the claims of the Messrs. Deidesheimer at this place. These crystals occur with placer gold 2,500 feet above the level of the river: but they are not much worn by transportation. Quartz crystals are found mingled with the auriferous earth with only their sharp edges and angles removed by attrition, which shows that the drift is comparatively local and indicates the presence of a parent vein in the vicinity. Most of the crystals have the peculiar triangular depressions in the faces, generally found in gold crystals, and some of them are very much distorted; others are flattened parallel to a face so as to become thin triangular plates. These specimens are seldom more than three-eighths of an inch across the base.

An imperfect octahedral crystal of extraordinary size was taken from the claim last year. The planes are only partially developed for a short distance above and below the basal ridges, and the peculiarity of a series of similar parallel planes, lying like plates one within the other, is presented.

The crystal is elongated in the direction of a line parallel with two basal edges and thus becomes a rectangular octahedron.

The length of the longer base is one inch, and the shorter seven-eighths of an inch. I believe this to be the largest crystal

ever reported; it may be called a *skeleton* crystal on a grand scale.

Arborescent and Dendritic Gold—Placer Co.—Some of the most remarkable and beautiful specimens of gold ever seen, have been found at Irish creek, three miles from Coloma. They simulate the veined and reticulated appearance of leaves and more closely resemble the foliage of the Arbor Vitæ or the fronds of the most delicate ferns than of any other forms of vegetation. The filamentous and arborescent masses are frequently united to plates (as broad as the hand) which are covered with lines of crystallization and are brilliant with numberless faces of partly formed crystals. They are also combined with good crystals which are generally octahedral and have perfect faces.

I have a very beautiful specimen of this character in the form of a leaf: one side is beautifully arborescent, and the other is studded with perfect octahedrons of various sizes and about twenty-five in number, including the smallest. They are geometrically arranged, all their similar edges being parallel. This is believed to be the most remarkable and beautiful specimen known. Its weight is 17 pwt. 10 grains. Length two and one quarter inches, width, one and a half inches.

One of the foliated specimens in my collection, bears a crystal having the form of a pentagonal dodecahedron with cavernous faces.

One of the largest specimens of this arborescent and foliated gold that has been procured, was about twelve inches long and about four broad. A part of the specimen was a plate three or four inches long, covered with triangular marks; the remainder was arborescent, and the whole appeared to have grown from one end.

Another specimen slightly different in its character and prob ably from another locality in the vicinity, was ten inches long, three broad and about half an inch thick. It weighed 31 ounces, and was free from quartz; forming a most beautiful mass of a rich yellow color and a delicately marked surface, consisting of a net-work of fibres. It appeared like a bundle of broken fern leaves closely matted together.

These specimens are evidently from a quartz vein, but although I have visited the locality, I have not been able to see the place from which they were taken, or to obtain any reliable information concerning their mode of occurrence and the associate minerals. Some of the foliated specimens were encrusted with a thick scale of sesquioxyd of iron.

The locality is about three miles from Sutter's mill—the point where the gold was first discovered.

Platinum.—The occurrence of this metal and its associates with the gold of Port Orford, has been previously noticed in this Journal. It appears to constitute a large percentage of some of

the samples of gold brought from that region, and this renders the locality peculiarly interesting. Several ounces of the mixed metals were obtained, and are now being carefully examined. The platinum is in very small thin scales and is easily lifted by a magnet. The difference in the specific gravity between this metal and gold is beautifully shown by the newly invented separating machine,* which distributes black-sand, gold and platinum in separate zones at the upper edge of the oscillating copper table.

I have found platinum in small quantities in the gold of the Middle mines, and in the fine scale gold from the forks of the American River, but it appears to exist in small quantity. It is an interesting fact that the metal is more common in the Northern mines, and that it is most abundant on the coast.

MERCURY.—*Santa Clara Co., New Almaden.*—The ore at this mine is a massive sulphuret (cinnabar) and its character and association have already been described in this Journal, vol. vi, p. 270, and xvii, p. 438.

The rocks at the locality appear to be metamorphosed sedimentary strata. They crop out at several places below the mine on the side of the hill, and consist of regular strata of argillaceous shales and layers of flint and jaspery rock, which resemble those of San Francisco near the Mission and Fort Point. Serpentine rock is found in and near the mine, and trappean rocks are also found in the vicinity.

The similarity of these strata and the serpentine to those of San Francisco leads me to consider them as of the same age at each place, and it is probable that the flint and jaspery rock is a metamorphosed portion of the blue sandstone formation of San Francisco.

Gaudalupe Mine.—This is another locality of cinnabar, about three miles from the New Almaden Mine, but it is not now worked.

Monterey Co.—Other localities are reported in this county, and at one point a vein has been opened by parties residing in Monterey. I have no definite information of its extent, but specimens of the ore of fair quality were exhibited in Monterey.

COPPER.—Small amounts of copper pyrites and green coats of the carbonate resulting from its decomposition, are found in many of the veins of auriferous quartz that have been opened in different parts of the State. I have not, however, yet heard of any locality that promised to reward explorations conducted for the copper alone. According to J. B. Trask, sulphuret of copper and the blue and green carbonates occur with quartz in Monterey Co. at Alisal; also in Santa Barbara Co. and San Luis Obispo.

A vein of copper pyrites occurs on the slope of the Great Ba-

* Invented by Horatio Bradford, Esq., of New York.

sin about seven miles east of Johnson's River. It is associated with quartz, and by its decomposition has produced abundant green crusts of malachite. Oxide of iron in fine powder is found in the cells and cavities of the quartzose gangue, and appears to have resulted from the decomposition of the pyrites. It is very probable that this vein is auriferous, but the specimens have not yet been examined. The vein traverses a micaceous granite and appears (from the outcrop) to have a width of over twenty feet, including the quartzose gangue. This is a valuable vein, and doubtless will show some splendid ore when thoroughly opened. Its discovery is one of the results of the geological reconnoissance in connection with the R. R. Survey.

Copper pyrites is also found in a vein about seven miles below the summit level of the New Pass, which leads from the Great Basin to the valley of San Francisquito. This vein outcrops on the southern slope of a granite hill on the north side of the Pass, and is about 90 feet above the bed of the creek. The ore resembles in its lustre and color the variegated copper pyrites, but is much softer. It is found in strings and narrow veins distributed through a hard quartzose gangue about fifteen feet thick: the thickest seam of ore, however, does not exceed two inches; but when several such were closely combined a thickness of eight inches of good ore was seen.

This vein has been prospected and a small quantity of ore broken out. It is about sixty miles distant from Los Angeles by the trail.

Native Copper and Red Oxide of Copper.—When visiting Camp Yuma at the junction of the Colorado and the Gila Rivers in December, 1853, several large masses of superior copper ore were shown to me by the officers of the fort. This ore was brought from the adjoining State of Sonora, Mexico, and the vein is reported to be near Altar. It is within the limits of the strip of territory recently acquired by purchase, and is therefore now in the United States. Specimens are frequently brought in by emigrants who cross the Colorado at the ferry below the fort. The ore is principally the red oxide of copper associated with the pure metal and green crusts of carbonate. The specimens that I saw ought to yield about ninety per cent. of pure copper. This is probably the ore that has recently excited so much attention in California, and has been reported to be highly charged with gold.

Calaveras Co.—Native Copper and Silver.—A specimen of pure copper combined with silver is reported to have been found in a placer mine near Mokelumne Hill. The specimen was exhibited in several places, and sent to San Francisco, but I have not been able to obtain any reliable information concerning it, or the circumstances under which it was found.

IRON ORES.—*Mariposa Co., Burns' Creek.—Limonite.*—An

outcrop of hydrous sesquioxide of iron or limonite occurs near the banks of this creek, on the right of the road going south. It is associated with a quartz vein and forms a bed about twenty-five feet thick, lying conformably with talcose and chloritic slates. The ore outcrops in great solid blocks from two to four feet in diameter; it is compact, of a dark brown color, and breaks with a smooth conchoidal fracture. The position and peculiarities of this ore indicate that it has resulted from the decomposition of pyrites, and that it forms the "gossan" of a vein of sulphuret below the surface. The mass does not, however, present that cavernous and friable condition in which gossan is generally found.

Magnetic Iron Ore.—A massive and fine-grained variety of this ore is found associated with one of the auriferous quartz veins of the county. Specimens that I have seen were colored green by their layers of carbonate of copper. It has polarity and lifts small fragments.

Tulare Co.—*Magnetic Iron Ore.*—This ore occurs in a bed or vein about three feet thick in a low ridge of white crystalline limestone at the summit of the pass known as the Cañada de las Uvas. The ore is compact but not crystalline; when broken it shows a brilliant fracture and a granular surface, and does not break with flat faces, like the massive magnetic ores of New York and New Jersey.

New Pass.—*Magnetic Iron Ore.*—Specimens of very pure and highly crystalline magnetite were picked up in the valley of this Pass: it is associated with hornblende, cinnamon-colored garnets and chlorite.

Placer Co., Volcanoville.—Large boulders of compact magnetic ore occur in the bed of the creek that flows by the side of the great vein of auriferous quartz at that place. These boulders are so large and abundant that it is probable that a vein of ore will be found in sites in that vicinity.

San Francisco Co.—The fissures and crevices in the serpentine rocks of San Francisco are occasionally drusy, with small but brilliant octahedral crystals of magnetite. They did not give reactions for chromium when examined before the blowpipe.

Sulphuret of Iron.—Good crystals of pyrites are obtained in the talcose slates in various parts of the mining region. At Georgetown, Placer Co., it is abundant in minute cubic crystals. They are obtained free from rock or gangue as one of the products of gold washing, and as they are very brilliant and of uniform size they are worthy of a place in good collections.

Chromic Iron.—*Monterey Co.*—Massive chrome ore of excellent quality was shown me in San Francisco, and reported to be from a short distance south of the Mission of San Juan. It is an interesting fact that it is almost identical in its appearance with the ore from "Wood's pit," in Maryland, and like it, is partly covered with green coats and crusts of emerald nickel.

The extensive distribution of this mineral in California has been noticed at length by Mr. P. T. Tyson in his report.*

ANTIMONY.—*Tulare Co.*—A large vein of the sulphuret of antimony, (antimony glance,) exists in the high granitic range that borders the Tulare valley on the south. It is about eighty miles from Los Angeles and is most readily visited from the Tejon. By observations with the barometer, I found the outcrop of this vein to be at an altitude of about 6,000 feet above the sea. It is on the side of a precipitous ridge of granite and not favorably situated for examination. Its thickness was estimated to be ten feet or more. A steep chasm or channel extends from the top of the ridge to its base, and is partially filled with rocks and the debris of the vein. Solid blocks of the ore were found with this accumulation, having been broken out from the vein above; one of them was 27 inches long and 16 to 18 wide.

The ore is associated with quartz, and where it has decomposed, an abundance of antimony ochre is found, together with crystals of selenite. Specimens of quartz traversed by long prismatic crystals of the ore were obtained.†

SALT.—Salt is found in small quantity as an incrustation or efflorescence on the soil along streams or on the margins of ponds in nearly all parts of California. It appears to be most abundant in connection with the tertiary strata and in the streams that flow from them. It is doubtless the fact that a great part of the incrustations called soda, consist principally of common salt.

Tulare Co.—*Cañada de las Uvas.*—There is a small shallow lake near the central part of this Pass fed by springs and streams from the adjoining valleys and ridges which are partly of tertiary strata. During the summer season the water of this lake evaporates, and its bed becomes covered with a white crust of salt which glitters in the sunlight like a field of snow.

Taheechaypah Pass.—A lake of a similar character to the one just described is found in one of the elevated valleys of the Sierra Nevada near this Pass. At another locality in that vicinity and near the margin of the Great Basin, salt occurs in a thick bed, from which over one hundred mule-loads have been taken, and carried to the Tejon Indian reservation for the use of the Indians.

This salt is perfectly white and amorphous, being reduced to fine powder by simple pressure. It is sufficiently pure for table use.

Dry salt lakes are also found near the termination of the Mojave River in the Great Basin, and at many other places throughout Southern California.

* Ex. Doc., No. 47. 31st Cong., 1st Session. (Senate.)

† A more detailed notice of this locality will be found in the author's Preliminary Geological Report accompanying the Report of a Reconnoissance and Survey in California, by Lieut. R. S. Williamson. House Doc., 129. 1855.

Los Angeles Co.—Salt is now manufactured in large quantity from sea-water by solar evaporation on the coast near Los Angeles.

Lower California.—A dry salt-lake has been discovered about 250 miles south of San Diego and near Marguerita Bay. It forms a thick bed and is very pure, being well crystallized in large hopper-shaped crystals. It is reported that the locality has been purchased by capitalists and that the salt is being shipped from there in large quantity.

GYPSUM.—Transparent plates of selenite are common in the soft unconsolidated tertiary strata in various parts of the state. At some localities it forms seams or beds several inches thick lying conformably with the stratification. In Tulare Co., at Ocoya Creek, these transparent plates are found in the Miocene strata; some of them are combined with the fibrous variety, and form beautiful cabinet specimens. Good crystals are also found in this county, at the antimony localities. Thin transparent plates are numerous in the Miocene strata bordering the Colorado Desert, and on the borders of Carrizo Creek they are found lying loose upon the surface where the strata have been worn away by the rains. Seams of gypsum are numerous in the tertiary strata of Benicia.

Wherever I saw the gypsum in the tertiary strata, it appeared to have been formed by the infiltration of sulphates and their decomposition by the lime of the beds.

BITUMEN.—The occurrence of bitumen springs in the Coast Mountains has been noticed in the writer's preliminary Report.

Near the Pueblo de los Angeles, there is a large pond or lake of the bitumen about one quarter of a mile in diameter. Its central portion is soft and semifluid but the outer parts are hardened by exposure. The material is much used for covering roofs, and at Monterey I saw a good basement formed from its mixture with sand and gravel.

SULPHUR.—Very interesting specimens of sulphur can be obtained at the Geysers or hot springs in Napa Valley. It occurs in crusts or lining fissures in the soil and tufaceous deposits around the springs, and is in small crystals, forming drusy surfaces.

BERYL?—*Tuolumne Co.*—Small and well formed hexagonal crystals having the hardness and color of beryl have been obtained from the Tuolumne River three or four miles from Jamestown. The specimens that I saw were apple-green and one of the smallest was emerald-green and transparent. The largest crystal was nearly $\frac{1}{4}$ of an inch in diameter and terminated at both ends with the planes R, and $-\frac{1}{2}$, as in tourmaline. I was unable to retain the specimens for further examination.

TOURMALINE.—*San Diego Co.*—Black tourmalines of unusual size (from six to eight inches in diameter) occur abundantly in the huge feldspathic veins that traverse the granite ridges bor-

dering the elevated valley of San Felipe, in the mountains between San Diego and the Colorado desert. These crystals are not perfect.

Feldspar.—Orthoclase.—*San Diego Co.*—Good crystallizations of this mineral can be found in the granite veins near the road between Santa Isabel and San Pasquale. They are associated with tourmalines and garnets.

Andalusite.—*Mariposa Co.*—This interesting mineral was found in great abundance in a conglomerate that caps the hills along the Churchillas Rivers (San Joaquin valley) at the crossing of the road leading to Fort Miller.

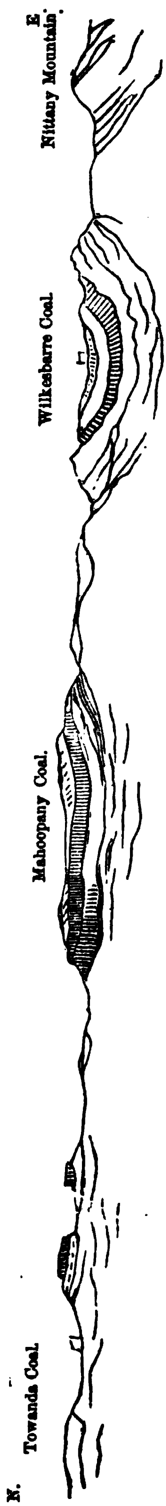
Very fine crystals of unusual size occur in the gravel along the bank of the stream. I picked up several that were two inches long and three quarters of an inch in diameter. They have a delicate pink or rose color and some of them are translucent. The peculiar tessellated appearance displayed in a cross section of crystals of this species, is exhibited by these specimens in a beautiful manner.

Calcite.—Crystallizations of this mineral are found at the Quicksilver mine, (New Almaden), at the Pass of Jacum, San Diego Co., and on the surface of the Colorado desert north of Carrizo Creek, where some transparent crystals were picked up. It also occurs in beautiful stalactites and delicate crystals in the great cave in Calaveras Co.

Art. V.—THE CUMBERLAND COAL FIELDS, TENNESSEE. By J. P. Lesley, Topographical Geologist.

I forward with this a sketch map of the Cumberland Mountain coal region in East Tennessee, to serve only to indicate the ground of my opinion, that mining operations there, in a supply of a central Tennessee coal trade, *must prove lucrative.* The great Appalachian coal region of Western Pennsylvania and Virginia narrows down through Tennessee, and tapers in several parallel fingers into Georgia and Alabama. Its eastern edge is perfectly well defined from the North Branch of the Susquehanna, round to Chatanooga, everywhere overlooking, from the crest of what is everywhere along that immense line the true Alleghany Mountain, the deep older secondary valleys between it and the great concentric curve of the Highlands, South Mountain, Blue Ridge, and Smoky Mountain. Its western edge is everywhere more uncertain and meandering, from its gentle dips, irregular denudation, and thinning out of those immense deposits of sandstone, and conglomerate, which fringe its eastern edge with parallel subordinate mountains. This great coal region may be said to have no spurs on its eastern, but innumerable spurs on its west-

ern margin. Towards the north-east, the rising of its sub-basins in that direction bring it to an end along the line of New York State, in six long slender parallel fingers, on the top of which the last remnants of the lowest veins, or vein, in fine, linger, and are mined for local trades; as, for example, at Blossburg, Towanda, Ralston, and the Mahoopany, in Pennsylvania. Such is also necessarily its manner of terminating southward in Georgia and Alabama; except in the three or four long mountain prongs, the Lookout, Raccoon, and Huntsville Mountains, which all retain upon their summits fragmentary patches of the coal, including the one, two, or three lowest beds. Our anthracite regions in the North repeat the same figured structure, as it were, in miniature, each basin throwing into the air bed after bed of coal, until the last outcrop of its lowest seam caps the extreme knobs of its particular mountain. Where the dips are steep and the basin narrow, the mountain assumes a canoe shape, and the coal is pinched or wedged in a crease along on top of its ends. But when the dips are gentle, and the region undisturbed, the mountain flattens and widens out into a high plateau, with perpendicular cliffs of conglomerate all around its upper edge, cut down by sharp and numerous ravines, and on its broad end, scarcely undulating back, rise here and there isolated mounds of regular aspect, around which come out upon their sides, all round, outcrops of the one or two lowest coal beds. I contrast the two forms of the coal in the following ideal section across North-eastern Pennsylvania, from Towanda towards Mauch Chunk:



That last described, and for example seen at Towanda, or rather at the Mahoopany, is a perfect illustration of the condition of the coal in Marion and Franklin Counties, Tennessee. That mountain, which, as the map will show, is a mere hogback at Montgomery's Gap, where (190 feet below the summit) the tunnel of the Nashville and Chatanooga Railroad passes, from the broad open country of Middle Tennessee, into the narrow valley of Crow Creek, on its way down to the Tennessee River, broadens northward so rapidly that in 12 miles it is 7 miles wide, and 25 miles wide where the Hillsboro' and Chatanooga old State road crosses it. The first supposed fragment of coal bed A lies under a little knoll (No. 1) about 7 miles north of the Gap, and is mined by Porter and Logan;* is quite horizontal; capped by 50 + feet of ferruginous sandstones and

* This tract now belongs to the Sewanee Company.

shales; is 3½ running down to 2 feet thick, and may yield five or ten acres superficial.

The next fragment crops out round a similar knob (No. 2) at Mitchell's, 14 miles from the Gap. This is the first on the Company's land; has a spread of 14 acres; has been long opened by neighboring blacksmiths around the outcrop, which is said to exhibit 20 feet of coal. The bed is evidently more than 10 feet thick, but how much more cannot now be seen for the water in the pits.

The third fragment underlies a somewhat larger knoll (No. 3) about a mile further on. The coal is, as before, horizontal, and spreads, at a rough calculation, 6 acres or more. How much more than 5 feet thick it is, I cannot say, because the shafts were abandoned at that depth on account of the water. At Wooten's, a mile further north-east, we arrive at what seems to be the beginning of the main body of the coal, as far as bed A is concerned. A steep irregularly scalloped escarpment (No. 4,) rises here from the broad plain of the mountain top, and along this, about one third of the way up, the outcrop of the horizontal coal has been repeatedly opened upon by shafting; but in no instance has it been properly opened; no preparation for draining being made, the water always filled the holes when about five feet of coal was cut.* How large the bed really is, remains to be discovered. Here it underlies hundreds, and, going northward, probably thousands of acres, and is the natural terminus of any branch railroad from the Nashville and Chatanooga Railroad, so far as the supply of the coal trade is concerned. Inasmuch as the Nashville and Chatanooga Railroad is already completed westwardly,† and will soon be so eastwardly, and inasmuch as no other railroad approaches as yet, or can for a long time open the coal of the Cumberland plateau to the north of it, except at great expense, the possession of these fragments and of this end of the great sheet of coal A, fourteen miles from Montgomery's Gap, must insure a virtual monopoly for the next few years of the central and west Tennessee coal trade.

In Nashville, Winchester, Murfreesboro', Shelbyville, and smaller villages, the demand for coal would justify a more costly outlay than that called for by this branch Railroad of 14 miles. Wagons have constantly carried the coal of Porter & Logan's Bank 14 miles to Winchester, and blacksmiths there prefer it at 25 cents per bushel to charcoal at 5 cents. The cost of mining ought not to exceed 1 cent, transport on branch road ½ cent, and on main trunk to Nashville 3 cents; thus assuming a cost of 6 cents the bushel to the coal yard at Nashville, and fixing the lump coal at 12½ cents, the running coal at 10 cents, and the dust for

* This has been thoroughly opened by the Company.

† The N. & C. R. R. is completed, and contracts made for transportation of coal for ten years.

blacksmithing at 8 cents the bushel, there would remain an average profit of 40 per cent. on the whole trade, or of about $1,25 on every ton. Although Nashville can be supplied at present only by steamboats ascending the Cumberland, there were over 20,000 tons said to be sold in the city last season, and at an average price of 20 cents the bushel. A railroad to the mines, by reducing the price, would immediately double or treble the consumption. The large coach factories of Winchester, 2½ miles from the Railroad, cotton works, grist-mills, steam saw-mills, casting foundries, and iron manufactories of Shelbyville, at the end of a branch Railroad 12 miles long; and the steam engines of Murfreesboro', on Railroad 55 miles from the junction of the Coal Mine Branch Road, stand ready to increase the consumption. The coal appears to be of a first class semi-bituminous steam coal, analyzing as follows:

Vol. matter—and water.
Carbon.
Ashes.

General Geology.—There is nothing peculiar in the coal series as here exhibited. I recognize the usual underlying and overlying rocks and kind of coal. The presence of the seral conglomerate (No. xii. of the Penna. Reports) furnishes a sure horizon of observation. It is a true white quartz pebble rock; the pebbles uniform in size and distribution, the size of a pea or a hazel-nut. I could not get its exact thickness, but learned that it made two layers, and judge it not to exceed 50 feet. It frequently tessellates with its naked faces, over which its small white gravel, weathered out, lies loose over the level or gently-sloping surfaces of the mountain plateau. Frequent brooks flow over it in both directions, and then, wearing through it at its edges, plunge into deep ravines down the mountain sides, through the underlying softer vespertine (x.) and post-medidial (viii.) sandstones, and finally by series of cascades over the outcropping limestones (vi.? ii.?) at the base, emerge into the plain.

Over the conglomerate are the ferruginous sandstones, slates, and shales of the coal measures proper; about 50 (*fifty*) feet over it occurs the main coal seam (A). In all respects it reminds me of the lowest coal-bed A on Broad Top, Pennsylvania, and I have little doubt may prove the same. It holds the same relative distance from a similar deposition of the conglomerate, and will be found, I think, to average and vary like it. The latter is, in reality, a 6 foot bed, but sometimes swells to over 14 feet. It is not so strange, therefore, that coal (A) should be between 3 feet thick at Logan & Porter's (No. 1,) and 20 feet thick at Mitchell's (No. 2,) 7 miles distant, *if these two beds be really one.* Nor must we be surprised if at No. 3 and at No. 4 it should prove to average but 6 feet hereafter in the shafts half sunk and now full of water.

Fig. 1.

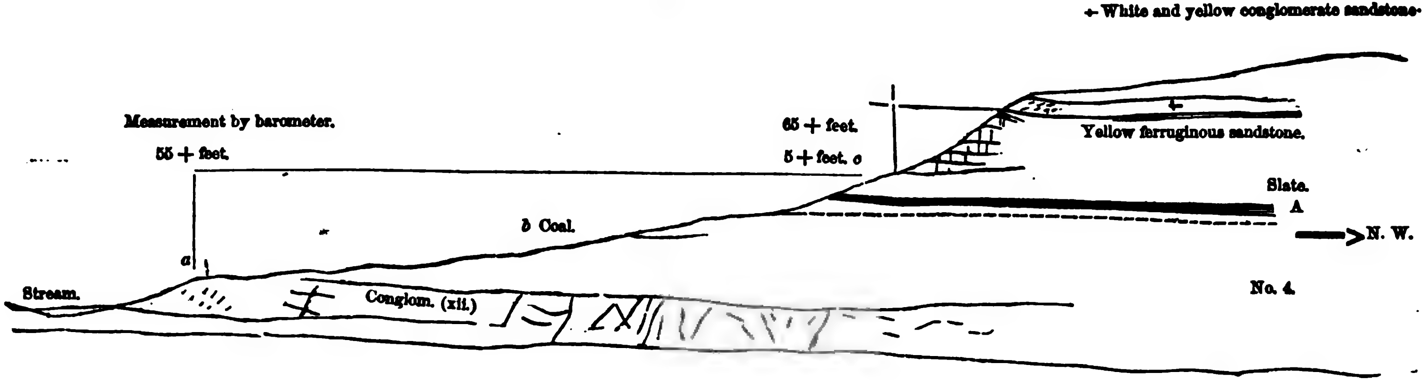


Fig. 3.

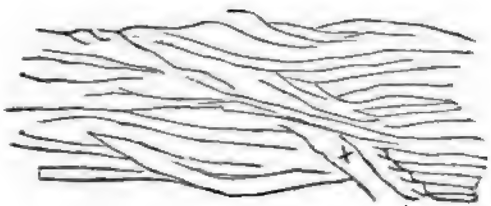
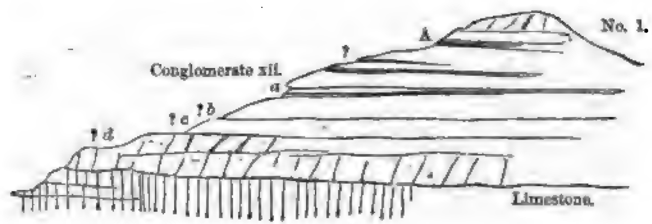


Fig. 2.



This, however, is the best possible working thickness for a horizontal bed of such extent, *and will endure the heaviest future coal trade.*

Between it and the conglomerate is, if I mistake not, a smaller vein (as on Broad Top,) opened in a shaft at No. 4. This may, possibly, be the Logan & Porter's coal-bed (No. 1). Over Logan & Porter's coal the ferruginous sandstone fragments are abundant and highly charged, forming conchoidal shards. Apparently the same ferruginous sandstone occurs in fine fragments above the new pits on knoll No. 3 (below the pits fragments of a hard, yellowish, oolitoid sandrock appear). It appears again over Mitchell's Bank (No. 2,) and again on the hill-side at No. 4, above the trial shafts.

Here a section would be thus: See Fig. 1.

A conglomerate sandstone, 65 + feet (by barom.) above the coal A, will hereafter be a valuable index to the Geology further to the north-east, where coal-bed B will make its appearance over it, and the rest above in order.

We have long since arrived at the conclusion, that the conglomerate formation (xii.) so called, is not so much a geological individuality as a convenient reference and name. In reality, several conglomerate deposits were thrown down in the intervals between the growth of the several lower beds of coal. Gravel and pebble-stones characterized the beginning of the coal era, as fine sand and mud its middle ages, and mud and marls its later and last deposits. In the Shamoken anthracite region, the five lower coals alternate with six distinct conglomerates, and above the twelfth coal-bed is still another similar one. Along Mine Hill the remarkable conglomerate of the great gray ash bed overlies 5 or 6 unworkable coal-beds, shut up among the underlying sandstones. In Virginia, the development of coals beneath the conglomerate is so remarkable, that they have been thrown into an older series, and classified with the great red, shale, vespertine formation.

I was not surprised, therefore, to hear Messrs. Logan & Porter's miner, Captain Kennedy, assert that he knew of four beds of coal underneath the conglomerate, at respective intervals of ten, fifty, twenty, and twenty-five feet. The difficulty in an uncleared country, among mountains, of identifying and classifying beds so near together, is too great to permit us to assume this as a well made out and established series; I will merely give it as thus reported in diagram, for the sake of reference. See Fig. 2. None of the under coals seem to be commonly of workable thickness (although one of them is reported at three feet) along the range of the mountain to the south-west of Mitchell's. Yet if they exist, they must underlie the whole plateau or summit of the range to Montgomery's Gap, and again south of that far into Alabama. It is probably one of these sub-coals that has been opened on Lookout Moun-

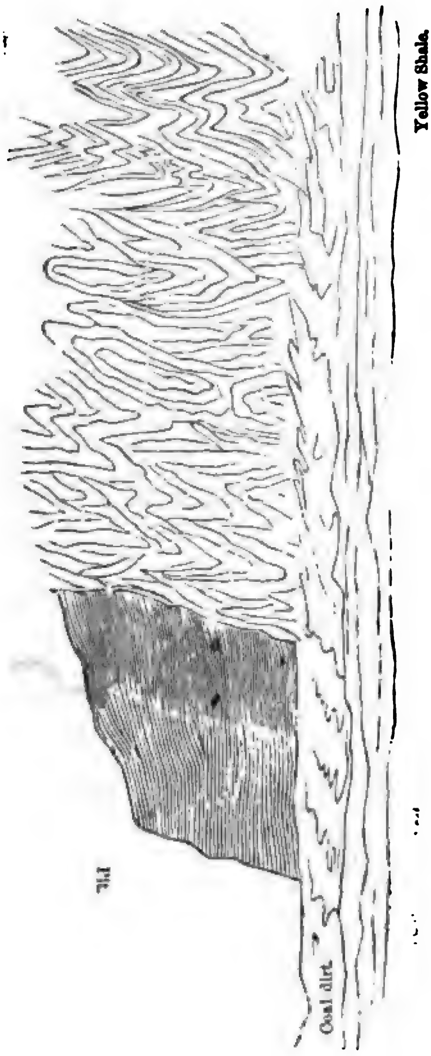
tain, near Chatanooga, and on Raccoon Mountain and Walden's Ridge. The conglomerate being the protective covering and true cause of these mountain table-lands,' whatever underlies it universally must be everywhere discoverable near the summits.

But when we get as far north as the neighborhood of Mitchell's Bank, the uppermost of these under coals (coal A) becomes of economical importance. It crops out under a cascade upon one of the Flat Rock head-waters, near Haines, about a mile south of No. 2, the cascade being over an outcrop of the overlying conglomerate, which here, as along all these head-waters, forms high bluffs on either bank.

The coal at low water shows about six feet in thickness; and if this be any thing like a fair exposure of its average size, the fact that it here underlies not only coal A, but also the conglomerate forming the seven mile wide summit of the mountain, *makes its value to the enterprise incalculable, because inexhaustible.*

I understood that coal had been mined at Thomson's (No. 6), about two miles south of No. 2, under a sandrock cover. It is, perhaps, Porter and Logan's coal, for conglomerate is said to crop out around it on the streams. The coal is good, and is hauled thirty and forty miles for use.

The substances of different beds, vary, not only according to the different beds, but locally, also, in the same bed. An ocean current will bring to one point more sand, and to another more mud, and strew pebbles along zones, between which there will be none. Lagoons through the original swamp vegetation were filled up with earthy matter, and form rock faults; in one place the coal grew in more disturbed and muddy water, and is therefore "bony;" in another the sulphuret of iron was more copiously deposited. The coals of this mountain, like all others, are sometimes charged with sulphur, and sometimes not. That of Mitchell's coal bank, and of the new pits opened at Nos. 3 and 4, seem very pure. It is a clear glance coal, equal to the finest specimens from the Barnett's Bank, Broad Top, but not so compact, and everywhere exhibits what at first looks like indications of a crush, a curved or distorted lamination. One wall of the great pit above the house shows a curious sort of false bedding (as may be seen in Fig. 3, p. 49,) and which certainly looks like a crush. But on the other is seen a clear and constant cleavage 'with a dip of 60° due south, and no doubt the result of an incipient metamorphism, or a voltaic crystallization. See page 52. On the sides of the other pit, and in the coal, the outcrop being perfectly undisturbed as far as the horizontal planes of the stratification in the slates or shales above were concerned, I remarked the foregoing curious structure, which I cannot for a moment assign to any known order of fault or crush acting upon so fragile a material as coal, nor to any lateral compression, such as produces the wave structure in certain solitary



strata of mud or sandrock, while sub and superincumbent layers are undisturbed —but to a peculiar crystallization, approaching the conchoidal, and yet acting in double converging planes. This occasions the peculiar distorted or bent lamination in hand specimens from this bed, and is certainly worthy of a close investigation. It is not confined to the extraordinary expansion of the bed at Mitchell's, but is observable at the other localities, and must therefore be a characteristic feature of a great extent of the bed. Economically, this phenomena cannot effect the analytical composition of the fuel, but diminishes its portability or resistance to wear and tear in transit.

ART. VI.—SCIENCE IN THE MINES.—BY HERBERT MACKWORTH.

THE want of popular information on the subject of mining may cause "Science in the Mines" to be looked upon, by many,

as involving more difficulties and mysteries than the other subjects to be found in the programme of educational lectures. By the aid of a little science, to explain and to illustrate, these difficulties will disappear; the empiricisms of the practical man will be found to belong to general rules, and the art of mining will be shown in each step of its development to be indebted to the labors of practical men of science. To prove this close relation, it might almost suffice to recall the names of those who have led the way in the improvement of the art; of Smeaton, Watt, Stephenson, Davy, Buddle, Wood, and Taylor in our own land, and of Werner, Humboldt, and Combes on the Continent. But to convince a miner (than whom no one adheres more stoutly to that much abused title, "a practical man") of the full scope and power of his auxiliary, a close investigation is necessary.

Experience is the foundation of science and skill. Reasoning on the results of previous labors, in order to overcome a difficulty of a new or a greater kind, is identical with the inductive process of the man of science. If it were possible to find a man in no way indebted to science, even the most rudimentary, such as the practical man assumes himself to be, he could copy or reproduce, but not better than many machines, and would be infinitely surpassed by them in economy and power. The instances are, unfortunately, very numerous where the practical man affects to despise the experience of others or the aid of science: he is ignorant because he restricts himself to his own limited experience; he occasionally indulges in the wildest speculations, because he will not understand the reason of what he does and sees; and certainly the mistakes which have been committed by the abuse of science are not to be laid in the balance with the enormous sums of money which are day by day squandered in this country by intrusting the charge of works, often involving novelty and improvement, to the hands of ignorant or uneducated men. I am not underrating the value of practical experiment and knowledge; it is the foundation of science, as science is of the advances of practice. There are three ways in which we have drawn from the exhaustless stores of science to supply our wants and enlarge our resources. We have made some progress by those brilliant though rare discoveries, the results it may be of accident or imagination, but which are linked to the useful and the known by the laws of science. Still more is due to the application of these laws to correct our judgment or performances, and to modify and improve our plans; but it is in its third remaining province that science is subservient to mankind at large; it explains, it generalizes, it becomes our guide, and spreads among men that knowledge by which the power of the head is added to and skills that of the hand. Nothing is too simple or too common to be beneath its sphere; from the food we eat to the latest success of agricultural chemistry; from the shaping of a pen to the machine which

prints 8,000 copies in an hour, and from the excavation of a quarry to the winning of a deep mine; we find, on examination, that whatever we at present call perfection we owe to the labors of applied science.

As the mines have been the birthplace of our railways and of the locomotive, and the nurseries of the highest engineering talent, it may be supposed with truth that they present extraordinary difficulties, and therefore, that under the pressure of necessity they force into activity the highest order of skill for their improvement. In fact, a Newcastle colliery presents the most remarkable illustration which this or any other country can boast of the successful application of science and experiment for successive ages to overcome the difficulties of practice. Many mining districts might be mentioned which are half a century behind the North of England in economical improvements; and as exhibiting the want of information amongst even the managers of mines in these districts, it may almost be taken as a rule that wherever minerals are abundant, near the surface, and easily accessible, there the most primitive, wasteful, and expensive methods are retained for extracting them. The entire cost of extracting and landing a ton of coal on the surface amounts to 3s 6d., whether it be extracted in Staffordshire from the 10 yard seam, from the Newcastle seams of 4 to 6 feet in thickness, or from the thin and extremely difficult seams of Belgium, which average 26 in. only in thickness. In South Staffordshire the barriers of coal and the faults have been recklessly driven through, and large areas are consequently drowned out by water; besides this, the system of working is so wasteful that one-half the entire seam is destroyed and left underground. A seam which contains 40,000 tons of coal per superficial acre rarely yields 20,000; whereas, in the same district, collieries have been worked which yielded upwards of 30,000 tons. In other countries the lessee is compelled to bring out the whole of the coal, and this indeed is the ground and aim of the interference of foreign governments with mining education. The result of the Staffordshire system is a scarcity of minerals, now pressing severely on the manufacturers of that district, but it is gratifying to find that the recent labors of the Geological Survey are bringing to light the existence of beds of coal and ironstone, which will happily compensate for the dearth caused by practical ignorance and error. The introduction of permanent competition in the trade will tend, as it always does, to the employment of science, and the result may be safely predicted in the shape of larger profits to the proprietor, and increased safety to the workmen.

A large mine is a very complicated machine. To understand thoroughly its working involves a study of boring, sinking, pumping, winding, hauling, getting, and ventilation. The most popular and correct account is to be found in Longman's shilling

series, entitled "Our Coal and our Coal-pits," and a similar work by the same author on the Cornish mines, which are the most important metallic mines, is issuing from the press. Some coal mines cover an area of two square miles, containing upwards of 160 miles of galleries, and 40 miles of underground railway. The shafts vary from 4 to 20 feet in diameter, and descend to depths of 600 yards in England, as at Monkwearmouth; and to 750 yards below the surface in Belgium. The mouth or eye of the shaft is covered by a lofty pyramid of timber, coal screens, engine-houses, and pumping and winding machinery. A direct-acting engine brings 2 tons of coal to the surface every minute, at a velocity of 20 miles per hour; whilst an underground engine, working an endless rope, draws trains of 50 wagons at a time from the extremity of working, two miles distant from the shaft, at the rate of 10 or 15 miles per hour. Upwards of 1,000 men and 50 horses are employed in driving, exploring galleries, in maintaining the roof, the roads, the ventilation, and regular working of every part, in extracting the coal, and keeping the trains and engines fully supplied. The largest metallic mines require the labor of 1,200 men, but they are seldom worked by the aid of horses or underground engines. They may contain 40 miles of horizontal galleries and 12 miles of shafts. They extend to depths, in Cornwall, of 750 yards beneath the surface, or below "grass," as it is termed.

We require the aid of mineralogy and geology to ascertain the nature and value of a mineral, its true position in the earth's crust, its probable abundance in particular strata, and whether it exists, in threads, bunches, veins, or lodes. On each of these points depends the outlay of capital which it may be necessary or desirable to make. By the same means we ascertain the best position to sink our shafts, so as to avoid water and faults, and to reach the lowest part of the work, that the excavation may proceed upwards, and all water and minerals descend to the shaft. Without mechanics it is impossible to select the most economical means and arrangements of transport, either in the mine or in the shaft; and to ascertain the relative economy of engines, and other machines, as well as to place the machinery in such mannner and positions as will obtain the greatest amount of useful work with the least expenditure of fuel. Pneumatics are essential to the knowledge of ventilation, on which the amount of manual labor, and the health and safety of the workmen, depend; whilst to chemistry chiefly belongs the analysis and preparation of the ore, and the choice of various processes for extracting metal of the most suitable quality. Can we hesitate to reccommend a course of instruction in these sciences as eminently practical in its nature? Can we have too many facilities for distinguishing the different strata in their mineralogical relations, for ascertaining the direction and contents of the included veins, the nature

of the produce, and the most efficient mode of exploring them? The drainage, whether by steam or by water-power, including the dimensions and placing of the engine, the economy of fuel, the preservation of the boilers, and the arrangement of the pit work, to be accomplished with certainty, must be founded on sound mathematical and mechanical, and I may add, chemical principles. And when the strength of materials shall have been correctly calculated, and the sinking of shafts in the right places, the blasting, lighting, and ventilation of the mine, and the descent and ascent of the miners perfected, and the ores are at length "at grass," can we yet decide on the best mode of dressing them? Can no improvments be made in crushing, stamping, or calcining? Can we from practice, or from any analytical skill at hand, at once determine what ores are sufficently rich in iron, manganese, silver, arsenic, cobalt, chrome, zinc, or sulphur, to warrant our pursuit or selection of them? The best mode of separating many of those substances, to say nothing of the smelting of our inferior copper ores, is still to be learned. Has not Pattison, by his scientific skill, added more than 20,000*l.* per annum to the value of the lead ores of England, and reduced the expense of extracting the silver by two thirds? I assert, without fear of contradiction, that however desirable the division of labor, and however conversant the mine agent may be with a few or more of his pursuits, circumstances constantly arise in which his experience alone will not guide him. I gladly admit that many of our engines and mining works, partly the result of the strong necessity, and the enormous expenditure and the scale in which innumerable trials were made, are models for imitation, and that we possess many men of genius and industry, who, after having laboriously groped their way for years, have given to their undertakings the touches of a master's hand. But in the interval how much has been lost to the country in the relinquishment of deep mines? and if we could analyze the long mental process, it would be seen how largely these men had imbibed from time to time the important truths developed by educated minds of deep thought. It must not be forgotten that this experience has often been obtained at a great expenditure of life, time, and money. If in the healing art the uneducated at length attain considerable proficiency, still the veil must be drawn over the death and suffering which marked his progress; so in mining the apprenticeship has often cost the lords the abandonment of valuable veins, and the adventurers sums varying from 100*l.* to 5,000*l.*, and without the benefit to be derived from communicating generally the causes of failure or ultimate success.

How often do we find the expense of boring or sinking shafts incurred before the geological nature of the country is ascertained. Large sums have, in this way, been squandered in searching for coal. About 40 years ago, at Wincanton and Oxford,

borings were commenced in the Oxford clay, and continued down to the oolite. The coal measures, if they exist beneath, being probably two thirds of a mile deeper still. Borings, equally unsuccessful, were undertaken at Chard, in the lias of Somersetshire, without a previous examination of the 30 miles of country intervening between this and the nearest point of the Somersetshire coal field. In 1836 a sum of 30,000*l.* was expended in sinking at Kingsthorpe, near Northampton, with the expectation of finding coal. The shaft passed through the lias and the oolite, and reached the new red sandstone at a depth of 320 yards, being stopped bythe influx of the saline waters of the latter series of beds. There is nothing within 20 miles of the spot to mark the dip or even the existence of carboniferous rocks, the depth of which below the surface ought not to be estimated at less than 700 yards. Several hundred yards in the coal strata may be penetrated without reaching a workable seam. Notwithstanding these practical objections, a company is now being formed to prosecute the enterprise. The oversight of the projectors in each of these cases has been in assuming dark clays, or ferruginous waters, or fragments of lignite, as indications of coal in rocks wh erescience has shown that it does not exist; and in failing to examine, geologically, the dip and thickness of overlying strata across the 20 or 30 miles which separate them from the nearest workings of coal. It were wise to commence at a short distance, and an ample field is open for such discovery in England with far more reasonable prospects of success; as in Cheshire, Somersetshire, or on the lines of several hundred miles in extent where the coal-measures on the flanks of the central rise of England descend underneath, and are concealed by the latter unconformable rocks. In these situations the deep boring system of Kind and Degoussee, practised on the continent, might be applied with success, and bring into the market a vast amount of additional mineral property. Numerous other instances of fruitless adventures for coal are to be found in the millstone grits of Devon and Yorkshire, and in the Silurian shales of Carmarthen and Merioneth, where a superficial knowledge of geology would have shown that no coal could exist. Since the demonstration, by William Smith, in 1816, of the regular sequence of fossiliferous rocks there have always been found persons still blindly incurring the heaviest penalties for the want of geological knowledge.

The first sinking of the Haswell Colliery was abandoned after an outlay of 60,000*l.*, in endeavoring to pass through a bed of quicksand. Geology, in acquainting the projectors with the nature of the rocks, might have warned them of this, and of the necesity of boring. The present shafts, sunk at a short distance from the former ones, avoided the difficulties of passing the quicksand. The Monkwearmouth shaft was nearly abandoned, in consequence of a difference of 100 yards in the calculation of the depth

to be sunk; this was afterwards found to arise from no allowance having been made for the denudation of the coal rocks, which were overlaid by the magnesian limestone.

In the absence of an acquaintance with mineralogy, blende has been mistaken for lead ore, and in another instance large quantities were thrown away under the name of spar. An iron-master supplied calamine, in lieu of iron ore, to his blast furnaces, until he found out his mistake by its evaporating up the chimney. Many thousand pounds worth of the sulphide and black oxide of copper have been thrown into the sea on the shores of Cornwall. On the other hand, the experiments of Prof. Plattner, in Silesia, have resulted in the remunerative extraction of one part of gold in 228,000, and in Siberia, with low-priced labor, one part of gold in half a million parts of sand will pay for separation.

As an example of the successful application of science and perseverance, verifying the predictions of the philosopher, the discovery of gold in Australia is familiar to all.

JOURNAL OF MINING LAWS AND REGULATIONS.

THE WEIGHT OF COAL.

In the United States Circuit Court, before Judge Grier, on Monday, an important decision was made, in the case of *Frederick T. Holt* vs. *The Steamer Miantonomi*. Appeal from the United States District Court. This was an action to recover a claim for furnishing coal to the steamer, and a decree was made in the District Court in favor of the libellant, for the sum of $1,958 20. The defence was, that the amount of coal furnished was not equal to the amount claimed, for that but 2,000 pounds to the ton had been received, instead of 2,240, as was claimed by the respondent to be the lawful ton weight.

Judge Grier decided, that a ton is 2,240 pounds, and not 2,000. The Judge said, that a company of grocers might as well meet and agree to reduce the number of ounces in a pound, and make the smaller number the standard of a pound for their customers, as for coal dealers to agree that the weight of a ton shall be 2,000 lbs., and furnish that amount to their customers. Referred to the clerk to make the abatement in accordance with the decree. C. M. Neal for the libellant, and C. Cuyler for the respondent.

This conflicts with a decision of the Supreme Court of Pennsylvania, which decided a case in Pittsburgh, a few months ago, that, according to the laws of Pennsylvania, a ton weight was 2,000 lbs.

QUALITY OF COAL.

We find the following case reported in the Philadelphia Legal Intelligencer, of March 23d, 1855.

Daniel Edwards, *vs.* Ephraim A. Hathaway. } In the District Court, for the City and County of Philadelphia. December term, 1854, No. 878.

Corrari C. J. Sharswood, February 28th, 1855.

J. C. Laycock, Esq., for plaintiff.

J. R. Ludlow, Esq., for Defendant.

This was an action brought to recover the price of 55 tons 600 lbs. of coal, sold to defendant, $165 60. The verdict was for the plaintiff $156 05.

The following written charge was delivered by the Court, on the following morning, when the jury found as aforesaid.

Gentlemen of the Jury:—

This is an action to recover the price of 55 tons 600 lbs. of coal, sold and delivered by plaintiff to defendant. The plaintiff, it seems, is the proprietor of a mine in Schuylkill County, and the sale was made for him by an agent in this city. That is, an order was given for the coal here, upon which it was shipped to defendant, he paid the tolls, and he received the coal by the railroad here in Philadelphia. The defence is, that a very considerable part of the coal thus received was slate or stone.

The general rule of law is, that upon the sale of any article of merchandise, the seller does not become responsible for the quality of the article sold—unless he either expressly warranted the quality, or made a false and fraudulent representation in regard to it. This rule, however, is subject to some reasonable exceptions. It does not apply where the purchaser has no opportunity of inspecting the article. Thus, if a man orders goods of a manufacturer, it is an implied term of the contract, that they shall be of merchantable character, if ordered to be made for sale, or fit for the purpose intended, whatever that may be. I take it the same modification of the general rule applies when a coal dealer gives an order to the agent of a mine, for coal to be sent to him from the mine, it is an implied term of the contract, that the coal shall be of a merchantable character. It would not be allowed in such a case, that the seller should, in compliance with such an order, send an article which, though it might still pass muster by the name of coal, was composed of one half slate or stone. It would be different if a man went into a coal yard and purchased a quantity of coal there lying. His eyes, in such a case, are his market, and if he distrusts his own judgment, he should take the opinion of those who are acquainted with the article, or require the seller to warrant. But a man's eyes are of no use to him when he is buying something in the bowels of the earth, fifty or a hundred miles distant.

In such a case, therefore, the purchaser may set up as a defence, in part, at least, the defective quality of the article received; he might refuse to receive it altogether; but if he pays the toll or freight before he has had an opportunity to inspect it, he is not absolutely bound for the whole price he agreed to give, but is entitled to a deduction on accoun tof the defects in the article sold. It is true, that if he keeps an article without making any complaint, or demanding an allowance, he will be presumed to have been satisfied. Good faith requires, that as soon as the defect is discovered, notice should be given to the seller, and a jury will be justified in disregarding evidence of bad quality, when the purchaser has gone on, used or resold the article, and made no objection until the vendor called upon him for payment.

Now to apply these principles in this case. It has been testified, that there are in the market, two different qualities of coal, a first and second quality. The agent of the plaintiff has testified before you that he did not sell the coal for first, but expressly for second quality. The price was $3; the price of first quality $3 25. At the time of this sale coal was scarce. Evidence has been given, that a considerable amount of coal of the same plaintiff, from the same mine and vein, was sold about the same time, in this market. It appears that the defendant had sold all this coal, and it is said no complaint was made until ten days or two weeks after, when plaintiff's agent called on defendant with his bill. The defendant seems to have sold his coal, after he discovered the defect, for good coal, but then there is also evidence that defendant had three or four men constantly employed in picking the coal, and it was his coal thus cleaned and purified which he sold as good.

Well, then, you have heard the testimony on both sides in regard to the quality of this coal. There is a difference in the testimony of the witnesses

who have been examined as to the ordinary quantity of slate or stone that is in marketable coal. Murray and Williams say, from half peck to one peck per ton. Hill and Zeigenfuss say, from seventy-five to one hundred lbs. The former may speak of the first, and the latter of the second quality. Murray says, he tried and found two hundred and seventeen lbs. in one ton. Williams confirms it, at least he says a wheelbarrow of slate could be picked from one ton. If we take seventy-five lbs. the ton as the average quantity of slate and stone in second quality coal, and, say two hundred lbs. in the ton of the coal in question, we have, it seems, one hundred and twenty-five lbs. of slate in each ton as the difference between this coal and ordinary coal of the second quality—that would be one sixteenth of a ton in weight. I do not say that the measure of deduction for the price of this coal should be one sixteenth of the price, a juster rule would seem to be one sixteenth of the cost of the coal here, that is the price and tolls, that would be thirty-two or thirty-three cents, but even this would not answer unless the jury add what would be the expense per ton of removing these one hundred and twenty-five lbs. of slate from the coal, so as to bring it up to the average character of second quality coal. It seems to me that this would be the just measure of deduction to which defendant would be entitled if the jury are with him upon the question that he has a right to ask any deduction at all.

THE RIGHT TO DRAIN MINES.

Wheatley v. Baugh.*

Brief of Argument of Plaintiff in Error.

This is a case of vital importance to the people of the State of Pennsylvania, who are deeply interested in the prosecution of the valuable mining operations which are now extensively carried on in various parts of the Commonwealth, and which are attracting capital and population within our borders. No State in the Union possesses the same mineral advantages with Pennsylvania, and it is the duty of all the departments of the government, to aid her citizens in developing them to their utmost extent.

Mines of coal, iron, copper, lead and tin have been worked for centuries in England, and on the continent of Europe, and until the last few years, no question like the present has occupied the attention of the courts of justice. This fact alone, would seem to show that no such right of action as is alleged by the plaintiff below, ever could have existed, for it is clear that such injuries must have been inflicted upon individual owners of property, from the very commencement of mining. They would appear, therefore, to have been regarded as *damna absque injuria.*

The well-known principle of the English law is thus expressed by Blackstone: "Land hath also in its legal signification, an indefinite extent, upwards as well as downwards. *Cujus est solum, ejus est usque ad cœlum,* is the maxim of the law upwards; therefore, no man may erect any building, or the like, to overhang another man's land: and downwards, whatever is in a direct line between the surface of any land and the centre of the earth, belongs to the owner of the surface: as is every day's experience in the mining countries. So that the word 'land' includes not only the face of the earth, but every thing under it, or over it." (2 Bl. Com. p. 18.) If, therefore, the owner of land having valuable iron, lead or copper ore in it, without any intention to injure his neighbor, and with due care, opens a mine within his own limits, and sinks shafts, and makes adits, and takes out the ore, he is not responsible to any adjoining proprietor for any damage that he may sustain thereby. It is in such case *damnum absque injuria,* because he is strictly exercising a legal right. If, in consequence of the excavation, water accumulates in the mine,

* Continued from page 386, Vol. IV.

it is not only his interest but duty to expel it, so that the public may be benefited by the product of his labor. In the present improved state of machinery this is done by steam-engines, and in some mines the quantity of water expelled has varied from 2,000 to 3,000 gallons per minute. In mining operations, it is of course always necessary for the adventurers to keep the works free from water. In effecting this purpose it frequently happens, that many natural springs and streams are directed into one channel, and the united waters are brought out to the surface at the mouths of adits and levels.

The questions, therefore, with regard to subterranean water in such cases are entirely distinct from those of running water on the surface, and always have been governed by different rules, arising from the necessity of the case. In the city of Philadelphia, prior to the introduction of the Schuylkill water, its citizens were supplied entirely by well-water, but it was never understood that one individual by sinking a well on his ground could deprive his neighbor of a similar privilege. "Water," says a learned Judge of the Supreme Court, "for the support of all animal life, as well as for the support, health and comfort of private families or individuals, is to be obtained in every place of our country, at least by digging into the bowels of the earth, if not on its surface." This would have been an enunciation of false doctrine, if an owner of a farm was not permitted by law to dig a well upon his own property, because it interfered with the spring or well of a proprietor of another farm one or two miles off. The result of the doctrine contended for by the plaintiff, in this case would be, that the owner of two hundred acres of land without any spring or water-course upon it might be absolutely prohibited from using the water within his soil, because a neighbor or a neighbor's neighbor had dug a well some forty years ago.

The earliest case in England, is that of Hammond v. Hall, which was before the Vice Chancellor of England, on 28th February, 1840, and was reported in 10 Simons, 551; and in a note it is said: "A report is given of this case, because a question was raised in arguing it, which was said never to have been discussed before, namely, whether a right or easement could be claimed with respect to '*subterranean* water.' The question there was, whether the owner of an old well can prevent his neighbor from sinking a well in his own land, on the ground that thereby the supply of water to the old well will be drawn off or diminished. Quotations were made from the civil law, and the opinion of the Vice Chancellor being unfavorable to the right claimed by the plaintiffs an injunction which had been granted *ex parte*, was dissolved."

The next case in order was that of Acton v. Blundell, which was decided in the Exchequer Chamber, on the 18th May, 1843, on error from the Exchequer. The cause had been tried before Rolfe Baron (now Lord Chancellor Cranworth), at the Liverpool Spring Assizes, 1841, who charged the Jury, that assuming that the defendants were guilty of the grievances alleged in the declaration, yet if they did proceed and act in the usual proper manner on the land of the defendant Blundell, for the purpose of working and winning a coal mine therein, they might lawfully do so; that the law had made no provision against it.

This case was very learnedly discussed in the Exchequer Chamber, and the arguments of counsel are admirably reported in 12 Mees & W., p. 324. The well in that case supplied a cotton-mill, and was rendered insufficient by the pits which were sunk and made on the defendant's ground, and which were worked in the usual and proper manner. These pits were drained by steam-engines, in order to win and get the cannel coal there. At the depth of about eighty yards from the surface, *large quantities of water sprang out from a stratum of rock*, which lay at that depth, and was penetrated in the sinking of the same pit. Chief Justice Tindal, says, p. 349: "But we think, on considering the grounds and origin of the law which is held to govern running streams, the consequences which would result if the same law is made applicable to springs beneath the surface, and lastly the authorities to be found in the books, so far as any inference can be drawn from them bearing on the

point now under discussion, that there is a marked and substantial difference between the two cases, and that they are not to be governed by the same rules of law." * * * "In the case of a running stream, the owner of the soil merely transmits the water over its surface, he receives as much from his higher neighbor as he sends down to his neighbor below, he is neither better nor worse, the level of the water remains the same. But if the man who sinks the well in his own land can acquire by that act an absolute and indefeasible right to the water that collects in it, he has the power of preventing his neighbor from making any use of the spring in his own soil which shall interfere with the enjoyment of the well. He has the power still further of debarring the owner of the land in which the spring is first found, or through which it is transmitted, from draining his land for the proper cultivation of the soil, and thus by an act which is voluntary on his part, and may be entirely unsuspected by his neighbor, he may impose upon such neighbor the necessity of bearing a heavy expense if the latter has erected machinery for the purpose of mining, and discovers, when too late, that the appropriation of the water has already been made. Further, the advantage on one side, and the detriment to the other, may bear no proportion. The well may be sunk to supply a cottage or a drinking place for cattle, whilst the owner of the adjoining land may be prevented from winning metals and minerals of inestimable value. And, lastly, there is no limit of space within which the claim of right to an underground spring can be confined. In the present case the nearest coal-pit is at the distance of half a mile from the well. It is obvious the law must equally apply, if there is an interval of many miles." This is corroborated by a curious fact concerning London wells. Messrs. Barclay, the London brewers, get their water from wells sunk so deep that they and the Messrs. Calvert, whose brewery is half a mile distant, upon the opposite side of the river, find they are rivals for the same spring. When one brewery pumps, it drains the wells of the other, and the firms are obliged to obtain their water on alternate days. The case of Acton v. Blundell, is referred to with strong approbation in Smith v. Kenrick, 7 C. B. 515, decided on 14th February, 1849.

At page 541, Maule, J., says, "The law upon the subject of subterranean rights was much discussed in the recent case of Acton v. Blundell, 12 M. & W., 324. The distinction between subterranean and surface rights seems to be this:—as to surface flows, parties acquire rights to them, because there is the acquiescence of every body, who has any interest in the matter. But as to underground percolations, no rights are gained, because nobody knows any thing about them," and at page 551, Maule, J. says, "The Court in Acton v. Blundell, seemed to have adopted the doctrine there cited from Marcellus, Dig. lib. 39, tit. iii., § 12: 'cum eo, qui in suo fodiens, vicini fontem avertit, nihil posse agi, nec de dolo actionem: et sanè non debet habere, si non animo vicino nocendi, sed suum agrum meliorem faciendi, id fecit,'" and at page 558, Maule, J. says, "Nobody suggests that an action will not lie for *wrongfully* turning water into another man's mine," and in answer to a quotation from 3 Kent's Comm. p. 436, "the principle is, that every man is bound so to deal with his property as not to injure the property of others," he said, "a man may very well justify the consequences resulting from the legitimate use of his own land, but if he acts negligently or capriciously, and injury results, no doubt he is liable."

The case of Dickinson v. The Grand Junction Canal Company, decided 18th January, 1852, was upon a case stated for the opinion of the Court of Exchequer, by the order of Lord Langdale, the Master of the Rolls, and turned mainly upon the construction of an act of Parliament, and an agreement under seal between the defendants and the plaintiffs.

The company sunk a well, and erected over it a pump and steam-engine, by which they pumped into their summit level a quantity of underground water which would otherwise have flowed, underground, into the river Bulbourne, and also a quantity of underground water which would otherwise

have percolated the intervening chalk and earth, underground, into that river, both of which quantities of water would, in the natural and accustomed courses of the rivers Bulbourne and Gade, have flowed to the plaintiff's mills, and have been applicable to the working thereof. In the argument of this case Mr. Peacock said, "It is true that in Acton v. Blundell, 12 M. and W. 820, it was held that the owner of land through which water flows on a subterraneous course has no right or interest in it which will enable him to maintain an action against a neighboring proprietor, who in carrying on mining operations in his own land in the usual manner, causes the well of the former to become dry. But that case is distinguishable from the present, inasmuch as there the plaintiff had enjoyed the benefit of the underground water for less than twenty years, and the defendant merely excavated his own soil in the ordinary and reasonable use of it. Here the defendants have sunk a well, but for a purpose wholly foreign to it, namely, the pumping away to supply a canal." * * "Assuming that he may sink a well, for the purpose of cultivating his land, or getting coals or minerals, and thereby drain his neighbor's well, he clearly cannot do so for a purpose wholly unconnected with the ordinary use of the soil," and he says the true principle is found in the Digest, lib. iii. 39, tit. 8, De aqua, et aquæ pluviæ arcendæ. Art. I. iii.; and the same distinction is takea by Pollock, Ch. Baron, in delivering the opinion of the Court.

The Master of the Rolls, on April 2, 1852, upon a motion for an injunction in the case of Dickinson v. The Grand Junction Canal Company, after the questions had been answered in the Court of Exchequer upon the case sent to them as before stated, granted a perpetual injunction, upon the ground that the company had violated their contract, which had been sanctioned by an Act of Parliament. This case, therefore, does not interfere with the principle solemnly settled in Acton v. Blundell. The case before the Master of the Rolls, is to be found in 15 Beaven, 260, 19 E. L. & Equity, 287.

The decision in Acton v. Blundell has been followed in Roath v. Driscoll, 20 Conn. 533; decided in July, 1850, and was anticipated by the case of Greenleaf v. Francis, 18 Pick. 117, decided in 1836.

In Parker v. The Boston and Maine Railroad, 8 Cushing's Rep. 107 (1 Am. Railway Cases, 546), decided in January, 1849, there was a claim for damages in regard to a well. The Court said, p. 553, "the claim for damages on this ground does not depend on the relative rights of owners of land, each of whom has a right to make a proper use of his own estate, and sinking a well upon it is such proper use: and if the water by its natural current flows from one to the other, and a loss ensues, it is *damnum absque injuria.*" See Commonwealth v. Fisher, 1 Penn. Rep. 467, 1 Watts & Serg. 353. See also, Railroad Co. v. Yeiser, 8 Barr, 367.

The conclusion then to which the argument brings us, is that the plaintiff below has no cause of action against the defendant, because he was exercising a legal right upon his own land, for a legal purpose, and in a legal and proper and usual manner, and that if the plaintiff has sustained damage, it is strictly *damnum absque injuria.*

To illustrate the law upon this subject, we annex some quotations from the civil law, and also some observations by that very learned civilian, Dr. Bowyer.

Bowyer's Readings in the Temple:—1st Reading, p. 8. "In the administration of justice, by the combined services of the Bench and the Bar, we cannot fail to see the value of a broad cultivation of the science of jurisprudence. Cases frequently occur in our Courts, for the decision of which the precedents and books of authority afford insufficient or no rules. In such cases, as the Judges are always desirous of following the dictates of reason and substantial justice,—it must be a great advantage to an advocate to have at his disposal the vast mine of equitable principles, and legal reasoning to be found in the Roman Law and the writings of the jurists. And the science of jurisprudence must be most valuable to a judge, where he finds himself forsaken, or imperfectly assisted, by the guides on whom he is accustomed to rely.

"One instance of a case of this description will suffice, though many could be cited; and indeed it might be shown that the difficulties attending the settlement of the rights and liabilities of shareholders and provisional committee men, would have been diminished by the assistance of the great civilians and jurists. I refer to the case of Hammond v. Hall, 10 Sim. 551.

"The question raised in that case, on motion to dissolve an injunction, was, whether the owner of an old well can prevent his neighbor from sinking a well on his own land, on the ground that thereby the supply of water to the old well will be drawn off or diminished. The case was argued by counsel of the greatest eminence, and I perfectly remember that there was a paucity of English authorities on the question in dispute. But there are principles in the Roman Civil Law (in the titles on the Aquilian Law, and De Regulis Juris) and in Grotius, b. ii. chapters iii. and viii., which afford a solution of the difficulty most reasonable and just. And the reason of the law on the point is given very concisely by Ulpian, in the 26th Law of the title of the Pandects, 'De Damno Infecto.' He says, 'Proculus ait cum quis jure quid in suo faceret, quamvis promisisset damni infecti vicino, non tamen eum teneri ea stipulatione.' * And he gives as an instance, the case of a man who prevents water from flowing from his land to that of his neighbor. The meaning of the passage is, that though a man be bound by the stipulation *damni infecti*,—that is to say, not to do any thing to injure his neighbor's property,—yet he is not restrained from doing any lawful act incident to the enjoyment of his own property. And the very point in question, in the case of Hammond v. Hall, is decided accordingly by Ulpian, in the 1st Law, of the title of the Pandects, 'De Aqua, et Aquæ Pluviæ Arcendæ.' He says, '*Denique Marcellus scribit, cum eo qui in suo fodiens, vicini fontem avertit nihil posse agi.*' And in the case of Acton v. Blundell, 12 M. and W. 353, the same doctrine was laid down in a similar case; and both the learned counsel at the bar and the Lord Chief Justice Tindal, made great use of texts of the Civil Law, and the writings of the commentators."

Dig. lib. XXXIX. Tit. II. De damno infecto, &c. Leg. 26. Ulpianus, [libro LXXXI, ad Edictum.] "Proculus ait quum quis jure quid in suo fecerit, quamvis promisisset damni infecti vicino, non tamen eum teneri ea stipulatione; veluti si juxta mea ædeficia, habeas ædeficia, eaque jure tuo altius tollas, aut si in vicino tuo agro cuniculo vel fossa aquam meam avoces; quamvis enim et hic aquam meam abducas et illic luminibus officias, tamen ex ea stipulatione actionem mihi non competere, scilicet quia non debeat videri is damnum facere, qui eo veluti lucro, quo adhuc utebatur, prohibetur, multumque interesse, utrum damnum quis faciat, an lucro, quod adhuc faciebat, uti prohibeatur; mihi videtur vera Proculi sententia." 1 Corpus Jurp. 667.

Dig. lib. XXXIX. Tit. III. De aqua, et aquæ pluviæ arcendæ. Leg. I. Ulpianus [lib. LIII. ad edictum.] § 11. "Iidem (Sabinus et Cassius) aiunt, aquam pluviam in suo retinere, vel superficientem ex vicini in suum derivare, dum opus in alieno non fiat, omnibus jus esse—prodesse enim sibi unusquisque, dum alii non nocet, non prohibetur, nec quemquam hoc nomine teneri. § 12. Denique Marcellus scribit, cum eo, qui in suo fodiens vicini fontem avertit, nihil posse agi, nec de dolo actionem; et sane non debet habere, si non animo vicino nocendi, sed suum agrum meliorem faciendi, id fecit." Id. p. 690.

Dig. lib. XXXIX. Tit. III. Leg. 21. Pomponius [libro trigesimo secundo ad Quintum Mucium.] "Si in meo aqua erumpat, quæ ex tuo fundo venas habeat, si eas venas incideris, et ob id desierit ad me aqua pervenire, tu non videris vi (vim) fecisse, si nulla servitus mihi eo nomine debita fuerit, nec Interdicto quod vi aut clam teneris." Id., p. 693.

J. J. Lewis,
John M. Read,
For Plaintiff in Error.

* And see L. 25, § 12 ff., De Damno Infecto.

COMMERCIAL ASPECT OF THE MINING INTEREST.

NEW YORK, *July*, 1855.

WE are glad at length to have to report an improvement in the marketable value of various mining stocks. This though owing principally to the continued abundance of money seeking employment, is owing in a great degree to the resumption of activity in the mines, many of which were wholly or partially suspended. The mining stock board has become more active, though the variety of stocks offered is not great. Confidence is, however, on the growth, and the steady working of the mines will produce further amelioration in the market of stock prices.

The coal stocks continue to take the lead. The Reading Railroad Company has divided 4 per cent. for the last half year's business. Its business has been large and profitable, and its stock has appreciated greatly. The Cumberland Coal Company have made a report, in which they announce a reduction of their bonded debt from $539,000 to $467,000, and that they will be able to make arrangements for the payment of the balance in 1856, when it becomes due. Their coal is becoming extensively used for railroad purposes. The Company mined 225,208 tons in the year ending April 30, yielding net $189,630, besides which the vessels earned $29,700, together $219,331. The available assets on 1st May amounted to $156,294, and the Company own 2,800 shares of its stock.

The demand for coal is greatly on the increase, and its high price is giving impetus to the working of additional mines. Canada is becoming a great consumer of our coal. The resumption of activity among the iron masters cannot fully supply the cash demand that has arisen at high prices for rails, for which $57 to $58 is now being paid and with an upward tendency. The scarcity of wood is leading to the use of gas coal for railroad locomotives. We hear, consequently, of new companies for working mines in Pennsylvania, Maryland, Ohio, Kentucky, and Illinois. The Breckenridge Coal of Kentucky is found to answer for gas and for oil, and its stock is consequently advancing. The rapidity with which the demand for gas coal increases, and the high price of Liverpool, render our bituminous coal fields more valuable. Among the new companies we notice the Clinton Coal Company of Pennsylvania, of which John C. Mallory, the hardware merchant, is President; it has a capital of $500,000 with privilege of increasing it to $1,500,000, in shares of $100 each. The mines are in Clinton Co. Pennsylvania, near the head-waters of navigation, which communicate by canal to New York City and Elmira to Philadelphia, Baltimore, and Havre de Grace, and has also a railroad communication to the large markets of the East, as well as those of the interior of New York, connecting at Elmira. The coal is a good gas coal, fully equal, according to various analyses taken, to the Newcastle or Liverpool Orrel Coal, and can be delivered by canal at New York for $4 50 to $4 75 per ton, which is far below the price of Liverpool coal.

The Company own 14,000 acres of land, covered with valuable pine, oak and hemlock timber, and containing rich veins of coal. 2,000 acres are only at first being opened, and these are found to have four veins of a thickness of from

4½ to 5½ feet thick. The quarrying of the coal costs only 50c. the coal being all above water level. The lands are paid for. A small railroad of eleven miles from the mines to the Sunbury and Erie Road is being built and will be finished by the 1st September, the funds for which, and for depot, and opening the mines, have been provided by the sale of $170,000 of the Company's 6 per cent. bonds, all purchased by the directors; a further issue of 80,000 and the reserve of 40,000 shares of stock comprise the remaining available means of the Company. Coal is being sold, and the largest demand comes from Western New York, at Elmira, where the Company find it more profitable to sell its coal. The expectations of profit arise from the prospect of furnishing coal at tide water markets at less price than other bituminous.

The Coal River and Kanawha Mining and Manufacturing Company, is the name of another company, whose property is on the Coal River, which flows into the Ohio and of which the stock, which is all paid up, sells privately at its par of $100 per share. Its President is Abram B. Clark, of the firm of Binnijer & Co. The coal of this company is valuable alike for domestic, gas, and oil making purposes, and it enjoys a near neighborhood by river and canal to the markets of Cincinnati, Louisville, &c.

The business at the Lake Superior Mines in copper this season has been very active; a party from New York and Boston, deeply interested in Lake Superior mining, have just returned from the mines and report very favorably of the improved condition exhibited there. The demand for copper continues to increase.

The only active stocks at the mining board have been Gardiner's Gold Company's Stock, of which some thousand shares sold at from $1 00 to $2 00 per share, but closing on the 21st July at $1 84. The President is now at the mines and reports that all the engines are fully at work and regular returns of produce may speedily be expected. The first three days of using the new amalgamator produced 330 dwts. or 16½ oz. gold, or $300, which is very satisfactory.

The stock of the McCulloch Copper Company has been selling at from $0 50 to $0 41, at which it closed on the 21st instant; this stock seems to excite more inquiry since the active measures recently taken to revive the work at the mine. The Aberdeen Company's stock has also been in considerable demand, and the price suddenly rose from 5 and 7 cents to 20 and 30, closing at 33, with some prospect of reaching 50c. as its friends say. The movement has been a speculative one. More also has been doing in the stock of the North Carolina Copper Company; sales have been effected as high as 84c. per share, which is a rise of 59c. from 25c. the price at which it stood for a long period.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

Without entering into a detailed statement of the operations in particular districts, it will suffice at this time to notice such particulars as are of general interest. The yield for the year is thus estimated in California.

The average yield of the gold mines of this State during the present season is fairly estimated at sixty millions of dollars per year, and every indication satisfies the belief that the yield for the year 1855 will fully equal that of any previous year since the discovery of the mines. The United States Branch

Mint in San Francisco, is coining at the rate of $100,000 per day, and if the facilities for coining were twice as great, there is sufficient gold dust on hand to keep the mint in full operation for several months to come. During the week ending Saturday, May 26th, the coinage of double eagles amounted to $615,000—being at the rate of two millions four hundred and sixty thousand dollars per month, of twenty-six working days.

It is estimated that the coinage of three months of the present year will equal, if it does not exceed, the entire amount of coinage during the preceding year. The dust is still coming in, in quantities of from one hundred ounces to half a ton, and the demand for coin increases daily. An effort is being made to increase the coinage to $4,000,000 per month, and it is estimated that this amount may be set down as the regular average after the expiration of the present month.

Calaveras County.—It will be hailed with general satisfaction, when we assert, that at the present time the mining interest in this section of country is more healthy and vigorous than it has been for years, and that more gold is being dug out now than in any previous year of our history. The great cause of this is that water is now conducted to almost every spot where pay-dirt can be discovered, and simultaneously with the commencement of operations in a new placer are the surveying, grading, &c., of additional water privileges. Thus the miner is accommodated, the resources of the country developed, and the material wealth of the country increased.

In that immense district of country lying along the forks of the Moquelumne River, very great improvement has taken place this year. A large population has located here, and discoveries of extensive placers have been made by these enterprising men. Immediately water courses were laid out, and the wealth hidden away in the gulches and under the hills will be shortly brought forth and made subservient to the wants of man. Again, on the Calaveras, at Stewart's Hill, discoveries of hill diggings have been made of almost fabulous extent and richness. On Thursday last Martin's Company took out $8,000, and another company takes out, as we are credibly informed, $5,800 daily. The claims on the hill average almost equally rich. At Carson's, we understand, a new "lead" has been struck this week, which prospected as much as three dollars to the pan. At San Andreas, the miners never were better rewarded for their labor; and at Campo Seco their success may be ascertained by the immense quantities of gold dust which are sold on Saturdays and Sundays. Altogether the mining interest is prosperous and progressing.

Respecting the geology of the rich county of Calaveras, the following statement respecting the inhabited portion, by William Patton, which accompanies the Report of the State Surveyor General will be found of interest.

The tract to be thus slightly noticed embraces an extent of country between the Moquelumne River and Middle Fork, and the Stanislaus and North Fork, longitudinally; and latitudinally, the space between the foot hills and the head-waters of the San Antonio branch of the Calaveras.

Part 1. The geological basis of the whole of this division is primitive, in which the metamorphic (or altered stratified) rocks occupy, according to a general estimate, say nine tenths of that tract. The oldest primitive rocks (unstratified), consisting of modern California granite, syenite, etc., are found principally in the east; but instances are not wanting in which masses of that rock show themselves at the surface in the middle districts, as a tract of about four square miles at Moquelumne Hill, and another westward of San Andreas.

There is sufficient evidence to show that the appearance of the latter exceptions at the surface proceeded from later igneous causes, and their upheaval took place at a period more recent than the formation of the same description of rock occupying the eastern districts.

Successively after this formation and upheaval, it is apparent that two distinct lines of igneous formation, running in a longitudinal direction, appeared through the metamorphic rocks in which they lay; the one appearing

in the longitude of the forks of the Moquelumne River—an injection of basaltic trap and green stone, in a well defined and regular line, throughout the county north and south; the other lying a mile east of the forks of the Calaveras, less regular, but not less decided, and principally formed through the means of the original bed rock being brought into a high state of incandescence. This line runs in a direction from San Andreas to Campo Seco.

It is clear that the tracts called the gold districts, have been subject to a very high and long continued degree of plutonic influence, which extended more or less over all the division herein considered, to a late geological period—most probably to the tertiary era.

Accompanying the graniform rocks eastward, is a group of quartz dikes, upon which many of the gold quartz mines of this county now worked are situated.

Accompanying the trapean system at the longitude of the forks of the Moquelumne, is also a quartz dike group, from the wreck of which has been derived many of the richest placer diggings of the middle districts of this county. And accompanying the incandescent line westward are other lines of quartz, on one of which is the Carson Hill lead, which has been traced southward to a great distance. This group has been the source of much of the wealth of the western placers.

The whole of the quartz dike system is evidently of plutonic origin, and the leads are true metallic veins. These leads run north-west and south-east, but join and branch off from each other irregularly, but in what manner, deeply below the surface, is unknown.

These items show in a very general way the nature of the agency to which the gold districts primarily owe their wealth.

Part 2. Subsequent to this epoch (the primary state of this tract, the features of which were apparently progressive up to the tertiary geological era without superincumbent change), the vast auriferous beds of (marine) conglomerates, forming partially the superficial wrecks of the above, have been deposited. Posteriorly arose the advent of the great volcanic period, and more recently the upheaval of the entire continent after the drift period.

A great extent of country in Calaveras county is covered with conglomerate or gravelly deposits, say to an area of 600 square miles in the aggregate—the principal accumulations thereof exist in the middle and western districts, but more abundantly near the extreme foot hills near the western boundary of the county, than elsewhere. Large conglomerate accumulations exist near the forks of the Calaveras and Moquelumne Hill—also near San Antonio, Vallecito and Murphy's.

Many of these deposits are covered by volcanic products of different ages and character, but the principal accumulations of that nature, in point of superficial extent, exist far into the eastern district herein treated of, where, near the head-waters of the San Antone, a geographical area of about 400 square miles may be seen in uninterrupted succession from one point of view, lying in a general direction from N. E. to S. W. This extensive formation consists of lava form products, in many well-defined conformable layers of immense superficial extent, and from 60 to 200 feet or more in general depth, according to the nature of the uneven surface of the primitive rocks or conglomerates upon which it rests. Near Pleasant Valley, 10 miles west of Double Springs, exist similar formations of lesser extent. Much of the same is also found near Moquelumne Hill.

Trachytic lava is found at the Calaveras Peak near Double Springs, at Moquelumne Hill, and Vallecito, forming excellent, durable and fire-proof building stone. A species of clink stone is often found with the volcanic formations. The principal part of the volcanic products have been subaqueously deposited.

Part 3. Micaceous altered rocks most commonly exist in the vicinity of the granites. Talcose schists are usually found near the great quartz leads,

to an inconsiderable extent, but where occurring are generally accompanied by richer auriferous deposits than common. There are talcose altered rocks containing lime, westward of the Calaveras Peak. These rocks are also occasionally alkaline. Plutonic alkaline rocks exist near Moquelumne Hill. Dark-colored clay slates highly indurated and crystalline, and quartz ore occur extensively almost every where in the tracts under consideration. Light-colored chloritic clay slates containing veins of quartz, occur west of the western quartz group.

Coinciding in general direction and position with the middle plutonic dike (mentioned as being in the longitude of the forks of the Moquelumne), exists an extensive bed of white or grayish marble, with blue veins, running entirely through the county southward. A species of travertine exists adjacent thereto in small quantities—the result of the denudation of the carbonate.

A bed of Calaveras (andesitic) porphyry lies near the forks of the Moquelumne, consisting of whitish nodules, in a black or gray base of angite or hornblendic. This as well as the marble (carbonate of lime) before mentioned, is a rock beautifully adapted to building purposes.

Metamorphic limestone is found near the Calaveras Peak, making tolerably good lime for building purposes. The Bear range is supposed to contain magnetic iron, as detached specimens have been found adjacent, on the surface. Platinum has been found in small quantities near the same locality. Gold bearing quartz and placers are also found in this range, but hitherto of limited extent.

Part 4. Within the Bear range are several fine valleys of small extent, well adapted for the purpose of agriculture. In one case a sulphuretted spring exists. Sulphur springs exist in many parts of the county, with a higher degree of heat than ordinary springs.

South of the head of the San Antonio River, a very porous, granular and coarse-grained granite abounds, containing fertile elements of vegetation in an eminent degree. Numerous springs of the purest water constantly issue therefrom. Several small valleys within this district are extremely prolific of vegetation. Gigantic pine timber abounds. The celebrated Mammoth Grove is on a basis of this rock in this locality.

Fine valleys of small extent are to be found upon the granite formation between the Licking and north forks of the Moquelumne, beyond Silver Mountain, north-east, highly capable of cultivation, with abundance of oak timber.

The volcanic formations are nowhere fertile, principally from the extreme porousness of these rocks.

The prolific nature of the valley of the Calaveras is so well known that it need scarcely be commented upon. It appears to proceed principally from the detritus of the felspatic and clay slates which it traverses in the middle districts.

The general prevention to the agricultural development of the mountains, appears to arise principally from the want of irrigation; more especially when the superabundant presence of one ingredient, as an alkali, iron oxide, or other mineral exists in the soil, requiring a corresponding corrective to latent as well as solar heat, tending to the retention of moisture. For example, I have observed that in our climate, soil highly oxidized with iron, too quickly imbibes the solar heat, and parches and destroys vegetation more rapidly in an exposed than in a sheltered situation from the direct power of the sun, as may be seen by comparing the north and south banks of any of our large mountain streams. These effects would be modified by irrigation in the situations where desirable.

Generally speaking, the superficial covering of the rocks in the mountains (if by the natural process of decay) is in a state of sub-soil, but wherever the retention of moisture takes place for a longer period than in any ordinary cases, as in the valleys of the extreme eastern or western districts, it becomes highly susceptible of cultivation.

TABLE MOUNTAIN.

Table Mountain, in Tuolumne county, California, overlies a rich deposit of gold, to reach which a number of companies have penetrated it with tunnels of considerable extent. To reach the gold it is necessary to bore through a rock of adamantine hardness, and from 600 to 1,200 feet in thickness. The density of the texture of this stone may be imagined from the fact that while two men, working constantly, may advance a foot a day, there are some places in which they have not advanced more than a foot in a month. It requires heavy and oft repeated blasts before it will yield even to the force of powder. The cost of boring these tunnels is from five to twenty-eight dollars per foot, but one company called the "Oliver," has already expended over one hundred thousand dollars in tunnelling about one thousand feet. In several instances, the whole outlay for such tunnels has proved useless, in consequence of mistakes in the direction of operations. For example, the Oliver Company, mentioned above, have had to run a second tunnel, and so have the Boston and Buckeye Companies, with hope still deferred. Table Mountain, the scene of these labors, is one of the wonders of California. It is thus described:

"Discoveries by those now engaged in tunnelling the mountain have established the remarkable fact, that underneath it is the bed of an ancient river; that this river was walled in on both sides by mountains of rock similar to those between which the Stanislaus and Tuolumne rivers now run; that a volcanic eruption, pouring an immense mass of melted lava into the river, has entirely filled it up, displacing the water, and forcing it into new channels, thereby forming Mormon Creek and other water-courses. Hence the level surface of the mountain; and hence its narrow and nearly uniform width and serpentine windings, through a course of about 40 miles, making it appear, to a person viewing it from a higher mountain, exactly like a distant river. Now it is only the channel of this river, varying from 25 to 40 or 50 feet wide, which affords the gold sought for by the tunnel companies. In order to reach this channel, it is necessary to pass through the immense walls of rock which curbed the river; and, if the tunnel should happen to strike above the bottom of the channel, an entirely new one must be run.

It may be mentioned as characteristic of California justice, that in some cases where the tunnels have been made at an immense expense, the claims have been jumped and infringed upon by interlopers.

Great Undertaking.—The Mountain Messenger welcomes the return from London of Mr. O'Connor. He has been absent about eight months, and returns to prosecute the most important work of bringing water to the dry diggings that has ever been conceived in California. This is nothing less than bringing the water from Truckie Lake to the rich placers of Sierra and Yuba counties, and although perfectly practicable is of the most gigantic character.—*State Journal.*

THE AUSTRALIAN GOLD FIELDS.

The Melbourne *Argus* contains an article stating the chief results of the late investigations of the Royal Commission in the gold fields of Victoria. The *Argus* says:

The fact of a very serious diminution in the production of gold was well known from the statistics compiled by Mr. Westgarth and Mr. Khull; but the immediate causes of the diminution, the change in the mode, and in the fields of operation, and their ultimate prospects, were not so well known; and upon these latter points the evidence before the Commission has thrown great additional light.

To show the falling off, we quote from the report the following table:

	1852.	1853.	1854.
Value of gold exported	£14,866,799	11,588,782	8,770,796
Valuation per oz.	70s	75s.	85s.
Value recorded by Customs	6,135,728	8,644,529	8,255,550
Population on gold fields	85,000	78,000	100,000

The apparent discrepancy between the amount cleared at the Customs and the amount actually exported in 1852, is to be accounted for by the large quantities sent overland to Adelaide and Sydney in the earlier stages of the gold discovery, and the extensive shipments in private custody which were not entered at the custom house.

The explanation given by the miners in regard to the diminished production is, that, by some singular accident, the auriferous drifts originally discovered were much richer than those more recently found. The diminution, in fact, would have been much greater had not machinery been of late very extensively employed.

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The theory of one of our scientific men is that the gold was thrown up by volcanic agencies at successive periods. The second bottom is the primitive rock, on which the gold is found frequently in large masses. At Balaret there appear to have been at least two volcanic disturbances and upheavals; and the depth to the primitive rock ranges about 200 feet. The gold is not in regular lodes, as in the quartz rocks, but in ancient water-courses. These courses are called leads, and the uncertainty of the course forms the principal mining difficulty. In truth, each sinking is a speculation, and it is of the greatest importance to reduce the expense of the venture. Hence the introduction of machinery for pumping and raising washing stuff and excavated soil and rock.

Hitherto we have discussed only the auriferous drifts, and we may mention that all who have studied the subject have long been convinced that, even with the advantages of machinery, there is a strong probability of a continued decrease in the production from this source. In some of our late summaries, however, we mentioned the discovery of the fact that our quartz rocks are highly auriferous, and upon the establishment of this fact a new era is opened up in the golden history of this country. The quartz is found, as in other countries, in regular lodes, and may be worked on mining principles. The depth of these lodes is various. In granite districts they are only about 25 feet, but we have heard of sinkings to the depth of 140 feet. Upon the establishment, therefore, of quartz crushing, Victoria emerges from the gold digging state, and becomes a gold mining country, with prospects of singular brilliancy.

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Mr. Selwyn, the Government geologist, in his last report on the gold fields, says: "I have no hesitation in expressing my belief that the gold fields of Victoria will prove as permanent a source of wealth to this colony as the tin and copper mines of Great Britain." We must confess that the evidence before the Gold Commission does not tend quite to corroborate this statement; but it is known that the quartz veins of New Spain are profitably worked three hundred years after their discovery, and there seems little doubt that even with machinery to the utmost conceivable extent, there must be employment in gold mining, and a very large supply of the precious metal in Victoria, for the present and a few succeeding generations.

GARDINER GOLD COMPANY.

Many inquiries having been made relative to the property of this Company, we extract from an early report, a statement of the same. The operations of the Company have been much enlarged and extended since the Report respecting their property:

The lands of the Gardiner Gold Mining Company are situated at the extreme northern boundary of Spotsylvania county, Virginia, about fifteen miles distant in a westerly direction from the city of Fredericksburg, directly on the line of the Rappahannock Canal, and at the immediate junction of the Rappahannock with the Rapidan River. The tract embraces an area of three

hundred acres, and has heretofore been known as the "Point of Fork Property," under which name it has acquired considerable celebrity, owing to the supposed richness of its gold-bearing quartz veins. This tract is owned, in fee, by the Company, free from all encumbrance, and is but nineteen hours distance from New York, by railroad, via Fredericksburg.

On completing the purchase, the Trustees despatched Mr. S. Hosack Mix, of New York, to examine and report upon the property. The following are extracts from his report:—

"The surface of the property, instead of presenting that rough and uninviting appearance so incident to mining districts, is uncommonly even and beautiful. The Rapidan River, a not inconsiderable stream even in times of the severest drought, courses for an entire mile along its westerly limits, and after sweeping in a bend to meet the waters of the Rappahannock, affords one of the finest water-powers to be met with in the whole country.

"The shores along the Rapidan River rise without abruptness, and at no point is there any great impediment to the laying out and construction of easy roads to and from that stream. There is now a very fine road leading from the centre of the property to the Grand Lock at the junction.

"The main operations in mining have thus far been carried on at a point about one fourth of a mile from the Grand Lock, and near the centre of the property. Here several cuts have been made across different veins, and *two hundred tons of ore*, as is estimated, have been raised, and are now deposited in one pile, convenient for removal or grinding up. A shaft has also been sunk to the depth of *forty feet*, for the purpose of striking from and leading out through subterranean passages to several veins. This work can at any time be resumed without protracted delay, the shaft being in good condition and well timbered, and protected against danger from caving in.

"About two thirds of the property is wooded with a fine growth of oak and pine. Very many specimens of the latter tree I observed as being of large growth and superior quality.

"A considerable amount of surface washing has been performed upon the '*Hunting Run*,' a small stream which forms a portion of the south-westerly boundary of the property. The washings, I was informed, had paid largely; and judging from the extent to which they had been carried on, there can be no doubt that such must have been the case.

"Several pieces of loose surface rock, picked up in the woods, upon being broken up gave gold to the naked eye, a few specimens of which I conveyed with me upon my return, and have deposited in your office. Some large pieces of ore, taken from the veins and pile, on being shattered, revealed surprising richness. Several specimens of this kind, picked up by me. upon the property, have also been deposited in the office of your company.

"The Rappahannock Canal is navigated by boats of the capacity of from *twelve* to *fifteen* tons. The navigation of the Canal frequently is not suspended for any portion of the entire year, and during the severest winters on record has remained closed but a very brief period of time. The Canal extends for about sixty miles from Fredericksburg, and large quantities of flour and provisions of various sorts are continually pouring in directly through this property, on their way to market. The property is situate from Fredericksburg *via* canal, about twelve miles. From Fredericksburg, steamers ply regularly to Baltimore, and a brisk competition in freights is always carried on by the rival lines between the two points. A line of schooners also regularly sail between New York and Fredericksburg, direct, freights on board of which are carried at less prices than between New York and Baltimore by steamers.

"An excellent plank road extends from Fredericksburg to within three miles of the property, and a good ground track, suited to loaded wagons of any capacity, completes the distance.

"In case that laborers should immediately be required on the property, hands can be secured at from $120 to $140, and efficient boys for driving teams at from $40 to $60 per year.

"An abstract of the title to the Gardiner Gold Mining property, was procured by me, at your request, from the records on file in the office of the clerk of Spotsylvania county, and is certified by that officer to be a correct transcript. This document, which establishes your clear and undisputed title to the premises, I herewith transmit with this report. I also submit a map sketch for your inspection, to enable you the better to determine the exact location, and the relation of the various portions of the property to the points of the compass.

"That gold in large quantities has been obtained in this vicinity, there is no doubt, and that the GARDINER GOLD MINING PROPERTY is not inferior to any in that section in the extent and richness of its treasures, past and present indications furnish incontestable proof. Well-directed effort is alone necessary to produce results the most profitable and satisfactory, and liberal enterprise is sure to reap remunerative rewards."

AURIFEROUS ROCKS OF SOUTH AMERICA.

The nature of the auriferous rocks of the most nearly allied and adjacent countries of South America is a subject which has not escaped the attention even of Baron Humboldt; his views may be thus stated in brief:—

The porphyroid rocks of equinoctial America form the prevailing geological type of that country, and no part of the world contains a greater mass of porphyries than the cordillera or chain of mountains which extend in America, almost in the direction of a meridian, 2,500 leagues from one hemisphere to the other. These porphyries, in part rich in ores of gold and silver, are most frequently associated with trachytes, by which they are covered, and through which the volcanic agents still penetrate. This association of metalliferous rocks with rocks produced or changed by fire, would less astonish the geologist of Europe if it extended only to specular iron, titaniferous iron, and muriate of copper, and not, as it does, to gold and silver. This latter phenomenon is striking, and is opposed to the opinions long entertained by celebrated men. It is, however, a fact very necessary to be well determined, that there is a proximity of position and sometimes an analogy in the composition of rocks, without an identity of formation.

The porphyries of South America may be considered in two ways; according to their geographical position, and according to the dates of their formation. These rocks occur together on a narrow land in the most western and most elevated part of the continent, on the shore of that immense basin of the Pacific Ocean, which is bounded on the other or Asiatic side by the volcanoes and trachytic rocks of the Kuriles, Japanese, Philippine, and Molucca islands. At the east of the Andes throughout the whole eastern part of South America, on a space of ground amounting to more than 500,000 square miles, no transition porphyry, nor real basalt with olivine, nor trachyte, nor burning volcano, have been observed, either in the plains or the groups of insulated mountains. The phenomena of the trachyte formation appear to be confined to the ridge and the line of the Andes of Chili, Peru, New Granada, St. Martha, and Merida. I announce this circumstance in a particular manner, in order that travellers may be induced to confirm it by farther examination, or refute it. In the same region, which extends from the eastern declivity of the Andes towards the coast of Guiana and Brazil, gold, platinum, palladium, tin, and an immense quantity of specular and magnetic iron, have been found; but amidst many indications of sulphuret or muriate of silver, no mine has been discovered which can be compared in richness to those of Peru and Mexico. I did not see transition porphyries, nor the porphyries of red sandstone, in the chain on the coast of Venezuela in the Sierra de la Parima, nor in the plains between the Orinoco, the Rio Negro, and the Amazon River.

With respect to the nature of the formations of porphyry which exist so

abundantly in the western and mountainous land of South America, and in that of Mexico, which is but a prolongation of the same land, I shall describe two very distinct groups in that place. The first (not metalliferous) reposes immediately on primitive rocks; the second, often metalliferous, rests on clay-slate or on talcose-slate with transition limestone; both of these by their position and composition sometimes resemble trachytic porphyries, as the porphyries of the group resemble those of the red sandstone. In fact, the transition porphyries of the Andes of Peru and Mexico are often found covered by trachytes, while the porphyries of some parts of Germany are covered by the secondary formation of red sandstone, which contains in its turn porphyries and amygdaloid. In equinoctial America, the limits between transition porphyries and real trachytes known to be volcanic rocks are not easy to fix. In ascending from the porphyries which contain the rich silver-mines of Pachuca, Real del Monte, Moran (porphyries destitute of quartz, but often abounding in hornblende and common felspar), towards the white trachytes with pearlstone and obsidian of Oyamel and of Gerro de las Navajas (mountain des Couteaux, to the east of Mexico), and in passing, in the Andes of Popayan, transition porphyries covered on some points with fine-grained black limestone, to the pumice-trachytes that surround the volcano of Purace, we find intermediary porphyritic rocks which we are tempted sometimes to regard as transition porphyries, sometimes as trachytes. To this may be added that midst these porphyries of Mexico, so rich in gold and silver, we observed beds (Villalpando, near Guanaxuato) destitute of hornblende, but containing slender crystals of glassy felspar. They cannot be distinguished from some of the phonolites of Bohemia. The transition porphyries of New Spain contain generally two species of felspar, the common and the vitreous. It appears that the latter is more abundant in the upper beds, in proportion as we approach the trachyte porphyries.

TESTING GOLD EXTRACTING MACHINES.

I will now tell the public an amusing fact of a trial which I lately made to instruct some young friends of mine, who were about leaving for the gold regions. I first placed a quarter of an ounce of gold dust, very fine, in a saucer, adding half a pound of quicksilver, and cold water sufficient to cover the whole, which I stirred up with my finger, to show the difficulty there was in making the quicksilver take up gold. I told them that time and friction would accomplish this; but, in order to hasten the process, I replaced the cold by hot water, when, after a few seconds, all the gold mixed with the quicksilver, leaving the dirt or earthy matter only. After taking away all the water, I passed the quicksilver through the chamois leather, when the amalgam remained in the latter; this I put on a clean plate of iron, and placed it on a blow, clear fire—in a few minutes the quicksilver evaporated, and the gold remained. This we again weighed, and found to be four grains less, which was found in the saucer, as dirt.

In order to prove to my young friends the efficiency of this process, I said I would astonish them by taking out more gold (apparently) than I put in, in my next experiment. I then took a stone of iron ore, bruised very fine, and put it into a large bottle, two thirds filled with the iron ore. I weighed out another quarter of an ounce of fine gold dust, and put this, with the same quicksilver I used before, into the bottle; then filling it with hot water, I shook it well for a little time, and emptied it into a large washhand basin. I then let a small stream of clear water run into the basin, stirring it well, until all the light portions of mud and other matters had been cleared; the heavier portions I passed from one basin to another, until all the dirt, apparently, had been taken out, re-passing the refuse a second time, to see if any portion of the quicksilver had escaped I then took the quicksilver from the water, and passed it through the leather, as before, placing the amalgam on the bright iron plate, and evaporated the quicksilver, when the weight left was found to be ten grains more than the quarter of an ounce I had put in.

How is this? said my young friends: when the first trial without the iron ore lost four grains, and this trial with the iron ore has gained ten grains—certainly the iron ore must contain some gold? No, I told them; it was simply that a portion of dirt had mixed with the amalgam, which had increased the weight; but, had it been assayed, in the first and last cake, as we termed the prill, the quantity of fine gold would have been the same. Oh! replied my friends, we now see how it has been with the machines for the extraction of gold: put in your nest-eggs, and out comes an increased produce. This is truly laying the golden eggs; but they and myself have pity on the poor geese who have suffered so much by laying their golden eggs, and are now mourning over their loss.—*Correspondent London Mining Journal.*

VALUE OF FOREIGN COINS.

From a report of the Director of the Mint, we gather some information of general interest as to the value of Foreign coins.

The gold coins of Great Britain, if not less than 915½ thousandths fine, are receivable at 94 6-10 cents per pennyweight: the gold coins of France, not less than 899 thousandths, at 92 9-10 cents; the gold coins of Spain, Mexico and Colombia, of the fineness of 20 carats, 37½ carat grains, which is equivalent to 869 14-100 thousandths, at 89 9-10 cents; and gold coins of Portugal and Brazil, not less than 22 carats, 916⅔ thousandths, at 94 8-10 cents.

Of the above only the coins of Great Britain and France fulfil the terms of the Act of Congress, and there is an upward tendency in the fineness of British coins; but neither class has been received here for recoinage for more than two years past, except in trifling parcels, owing to the course of trade which has cut off the importation of foreign gold coins.

The standards of gold coinage in New Granada, formerly a State of Colombia, are so entirely altered as to render the Act of Congress obsolete in respect to that coinage. The fineness of the doubloon has been raised to about 894 thousandths, but by decrease of weight it has fallen in value from about $15 60 to $18 30.

Of silver coins, the dollars of Spanish American coinage, and those restamped into *reis* of Brazil, as also the five-franc pieces of France, are made receivable at certain rates by the Acts of Congress; but as these coins are purchased at the Mint for recoinage at a premium, the provision for making them current may be considered nugatory and obsolete.

In general, the halves, quarters, &c., of these dollars are very near in fineness to the whole piece, but the public are informed that the half and quarter dollars of Bolivia, commencing with the date of 1830, and those of South Peru of 1835 to 1838, are greatly debased in quality, and worth only about three quarters of their nominal value. Such pieces are occasionally seen in our circulation. The fractions of a dollar coined within five years in Central America, or rather in Costa Rica, are still more depreciated, and very irregular, but their misshapen appearance will exclude them from currency here.

The Director of the Mint submits a tabular statement of the average weights and fineness, and of the value per piece and per dime of these dollars, according to the rate at which our dollars are coined:

Denomination.	*Weight.* Grains.	*Fineness.* Thous'ds.	*Value in cts.* Per. pc.	Prem.	*Price at Mint.* In cts.
Spanish pillar dollar and Brazilian restamped	412¼	900	100	116.36	122.50
Dollar of Mexico, mixed . . .	416¼	901	101	116.50	122.64
Dollar of Peru	415	906	101.2	117.14	123.32
Dollar of Bolivia and Chili . . .	416¼	902	101.2	116.63	122.77
Dollar of Central America . .	416	870	975	112.48	118,42
Five-franc pieces of France, mixed	384	·901	93.1	116.50	122.64

NEW COMPOUND OF GOLD AND MERCURY.

When gold is treated with mercury in large excess, a definite compound is formed, which remains dissolved in the mercury, from which, however, it often separates in a crystalline form, and from which it may be almost entirely separated by mechanical means, such as pressure through chamois leather. This solid amalgam crystallizes in four-sided prisms, and contains six parts of gold to one of mercury, and fuses on elevating the temperature (Gmelin, vol. iii.) The mercury, however, which has passed through the chamois leather, always contains gold, in proportion varying from a minute trace to 10 grs. in the pound. In the metallurgical processes for extracting gold, it becomes important to estimate the amount of gold remaining in the fluid part of the mercury, and it was during some experiments made with the view of ascertaining the best method of doing so that this new amalgam was discovered.

This substance is best obtained by dissolving gold in mercury in the proportion of 1 part of gold to 1000 of mercury about 7 grs. to the pound avoirdupois, squeezing the solution through chamois leather, and dissolving the mercury in dilute nitric acid with gentle heat. The compound is left in the form of four-sided prisms, of the most brilliant metallic lustre, which may be boiled in nitric acid without decomposition, and exposed to the atmosphere for months without becoming tarnished. On exposure to heat they do not fuse, but afford a sublimate of metallic mercury, amounting in my experiments to rather less than 12 per cent.; the form of the crystals remained unaltered, their lustre was little affected, and the residue consisted of pure gold. This would correspond to a compound of four atoms of gold to one of mercury :—

Au - - - - - - - -	197 × 4—788	or	88 74
Hg - - - - - - - -	100	100 "	11 26
Total - - - - - -	888		100.00

[By T. H. Henry, F. R. S., in the London *Mining Journal.*]

JOURNAL OF COPPER MINING OPERATIONS.

FLINT STEEL RIVER COMPANY.

The last Annual Report of this Company presents a few points of importance, as follows :—

The plan adopted of opening the mine from the end of the bluff, secures us important advantages in regard to transit, drainage, and ventilation; and when completed as laid out, will open a very extensive work. It was also deemed the most economical, in point of time as well as expense; for if *immediate* stoping for production had followed the drifting, the openings could not have been made to the desired extent, nor the necessary connections for ventilation completed before the heat of summer would prevent work in the long levels, and no stoping could then be done for the ensuing season.

As to the appearance of the veins at various points throughout the whole extent of ground opened to the present time, they are highly promising and satisfactory. At No. 1 shaft we have a good lode of barrel copper and stampwork near the bottom, and improving in the drift going west. The vein in the bottom of No. 2 shaft is nearly three feet thick, and also well filled

with barrel and stamp copper. In the adit level, the vein is regular and quite rich. The drift is extended under No. 2 shaft, where the vein is three to four feet thick; and at the only point yet broken, carries lumps of fifty to one hundred lbs. weight. There are several other places through this level, between the two shafts, where the vein also appears rich, and promises to yield well when stoped out. The second level is not yet proved to any considerable extent, but looks well so far as we have gone; and further west we expect to meet with something still better, judgng from the quality of the vein in the level above. After the ground is open to ventilation, it may be advisable to cross-cut south to a new vein, which was discovered on the surface late last fall, and the favorable appearance of which will fully warrant the undertaking. No doubt when we get the mine fairly opened for stoping, we can make the work profitable to the stockholders.

The quantity of mass and barrel copper forwarded from the mine last season (to November 1st, 1854) was 5,670 lbs., yielding 3,990 lbs. (or 70 per cent.) of ingot copper, which was sold for $1,018.95. The quantity now on hand at the mine, including stamp-work, is estimated at 10 tons, net value about $3,000. The Directors should, and no doubt will, procure a stamping engine the present season, to make available as early as possible the large quantity of stamp-work which will certainly accumulate as soon as stoping is commenced.

At the last annual meeting the Directors reported that 1,000 shares of the reserved stock belonging to the Company had been disposed of, and the proceeds applied to the expenditures; and that the remaining 1,000 shares were still on hand, no adequate price being offered for them. At the same time an assessment of One Dollar per share was levied on the outstanding stock, subject to the call of the Directors when the balance of the reserved shares should have been sold, and the proceeds similarly applied. The Company being then in debt some $2,000, and further means being required to meet liabilities and carry on the work before a satisfactory sale could be made of said stock, your Directors assumed the responsibility, for the interests of the Company, of calling in 50 cents per share in November last, believing the stockholders would approve and sanction their action under the circumstances, by a vote of this annual meeting. The propriety of such action, and the advantage resulting from it, are now apparent—for the still improving prospects of the mine on further development, have at length enabled us to dispose of the reserved stock to some of our already largest stockholders, on terms equal to five dollars per share, one half payable on the 16th instant, and one half in three months. The proceeds of said sale alone, however, not being sufficient to meet our expenditure to the present time, the balance of 50 cents per share due on the original assessment has also been called in, payable on the 20th instant.

The means thus furnished the Treasury will suffice to carry on the work to about the 1st of August next; by which time we shall probably be producing sufficient copper to render further assessments unnecessary for the balance of the year. But with the highest success we can reasonably anticipate for the present year, we shall doubtless require further means before the next annual meeting; and therefore it will be the duty of this meeting to levy such further assessment as they may consider proper or necessary, subject to the call of the Directors whenever required.

ABSTRACT OF TREASURER'S ACCOUNT.

To sales of Copper and Stock in 1853	$4,166.78
To do 1854	1,018.95
To Amount collected on Assessment of 50 cents per share, Nov., 1854. .	9,010.00
	$14,195.73
By amount of disbursements, as per cash-account and vouchers furnished	13,729.21
Balance in Treasurer's hand	$466.52

EXPENDITURES AND INDEBTEDNESS.

Amount of expenditures to February 1st, 1854	$4,246.97
" do " 1st, 1855	15,912.80
" do May 1st, 1855 (estimated)	5,000.00
	$25,159.77
Less, paid on account, as per Treasurer's cash-account and vouchers..	18,729.21
Amount of indebtedness May 1st, 1855	$12,430.56

RESOURCES.

Cash balance in Treasurer's hands	$466.52
Balance due on assessment of November, 1854	490.00
Sales of 1,000 shares reserved stock, and assessment thereon, at $5.00 per share	5,000.00
Assessment on 19,000 shares, due April 20th, 1855	9,500.00
Mineral on hand (not immediately available)	3,000.00
	$18,456.52.

HIWASSEE MINING COMPANY.

From the Third Annual Report of the Directors, we take so much as describes the business of the past year. The Directors say:—

On referring to the last Annual Report, you will observe that the calculations for an early dividend were based not upon the means actually in hand, for they were entirely absorbed by the Company's indebtedness, but on the *estimated* value of ore delivered and *en route*. You will also note, from the "*Statement of Ore Sold*," published with the same report, that the yield of the larger portion of that ore had ranged *from* 18 *to* 25 *per centum*, and that the last parcel (that sold to the Revere Company) gave 22 *per centum:* this we considered a fair average, and we should have felt justified in basing our calculations of the value of the ore *en route* upon that yield: we, however, reduced the standard to 20 *per centum*—purposely making our estimates fall short of what we believed would be the result.

Unfortunately the percentage of copper in some instances fell as low as 16 per centum, and in consequence the receipts from ore sold were very materially reduced.

The financial distress, which commenced as early as the month of June, bore seriously upon the smelters and consumers of copper, and was necessarily felt by the producers of ore. This was not so much occasioned by the sudden depreciation in the price of the metal, as from the stagnation in every branch of business: manufacturers could not sell their copper, and would not purchase ores except at low prices; and the consequence was that while our expenses remained unreduced, our receipts were materially diminished; and we necessarily, though with reluctance, abandoned the payment of a dividend.

Although we have not been able to meet the wishes of the Stockholders, we have nevertheless maintained the position and credit of the Company. Our expenses are at the lowest possible point: office expenses and salaries in New York have not exceeded three hundred dollars during the past year; but these must necessarily be somewhat increased, and we do not deem it prudent to have less than from 40,000 to 60,000 dollars of available means on hand, to conduct a mining business to advantage and with thorough economy.

From the statements annexed you will perceive that we have on hand, in cash and bills receivable, the sum of $35,566.37

From which deduct liabilities	4,576.34
Leaving a net gain of	$30,990.03

One thousand boxes (200 tons) of ore are now in Savannah, for which we have received bids; and 537 boxes more had left the mine previous to the 30th of April. *We make no estimates of value*, but simply furnish you with statements of actual results.

The Receipts for 20,34$\frac{2191}{2352}$ tons of ore sold and delivered amount to \$146,-033$\frac{66}{100}$: only \$9,887$\frac{50}{100}$ have been expended in taking out ore, and general labor in and about the mines: \$9,536$\frac{89}{100}$ in sinking the engine shaft and in other contract work: \$1,000$\frac{58}{100}$ have been paid for mules, steers, &c.: \$2,764$\frac{11}{100}$ have been expended on the Ocoee Road, and \$2,490$\frac{60}{100}$ in buildings and improvements.

The amount expended in cartage of ore to Railroad is enormous; our Company alone has paid during the past year \$27,500$\frac{93}{100}$, which might have been saved, were there complete Railroad connection with the mines.

On reference to the Account of Ore sent from the mines [No. 5] it will be observed that the shipments during the three months of November, February and March, were small and barely sufficient to meet the expenses. This was owing not to any want of ore, but simply to the fact that other Companies, by paying higher rates of freight than those which had been established, drew off the teams *temporarily* from our employ. The present rates of freight are sufficiently high, and we have deemed it inadvisable to join in any contest for the bringing forward of ores, since such measures cannot but result disastrously to the parties engaged therein.

It is pleasing to state that we have cut the vein in our cross-cut, *sixty feet* below the present level, and have found what was so confidently expected by some, yet doubted by others, viz., *the yellow sulphuret.* Up to the 3d instant, the lode had been penetrated only five feet. This cross-cut will now drain the mine to the depth of sixty feet below present drainage, and enable us to work that part of the vein from which, previous to abandoning on account of the strength of the water, we had taken the ore yielding 41$\frac{4}{10}$ per cent., as per Account, No. 6.

Report of the General Agent.

I have sent off since 1st May, 1854, to 30th April, 1855, 8,564 boxes of ore, weight gross 2,129$\frac{1137}{2240}$ tons, being within a few pounds of double the weight of last year's delivery; and we have in ore shed about from 350 to 400 tons dressed.

The greatest portion having been sent via *Charleston, Tenn.*, has made a considerable saving on our freight account, viz.:

2125	boxes ore,	weight	gross	1,193,429	lbs.	to	*Dalton*,	at 80c.	per	100 lbs.
2263	"	"	"	1,236,174	"	"	*Cleveland*,	at 60c.	"	"
4176	"	"	"	2,340,494	"	"	*Ocoee*,	at 40c.	"	"

Add 5 cents for boating to *Charleston*, gives the cost at Railroad at *Charleston, Tennessee*, 45c. per 100 lbs.

From the above statement, the average cost of cartage on one ton of 2,000 lbs., for hauling say 40 miles, is \$13; and the cost of the balance of route for Railroad, 510 miles, \$10 (and lately an additional charge of one dollar per ton for removal of freight across the *Etowah River*, by the State Road of Georgia, has been put on in consequence of the bridge having been burnt; which, however, is promised to be made passable in a short time.) At a heavy charge by Railroad, the same distance of 40 miles, say of \$1$\frac{50}{100}$ per ton of 2,000 lbs., would have saved this Company alone the enormous sum of over \$24,400 on our ores only—not taking into account the *up* freight of materials, &c., which costs \$8 per ton of 2,000 lbs.

I have no hesitation in asserting that a saving of over \$28,000 would have been effected by Railroad, without calculating the larger quantity of ore that would have been sent on, or the leaner ores, which would have paid by Railroad transportation, but under the present mode of transport must remain in the Tunnel.

Report of the Mining Captain.

Since the 1st of May, 1854, I have driven, in a north-east direction, 269 feet on the course of the lode, and communicated with the Green Shaft and boundary line.

On the south-west side from Main Shaft, I have driven 211 feet on the course of the lode: all the way the ore has proved to be productive.

I have sunk the Engine Shaft 144 feet, making its total depth at present 168 feet.

I have driven three cross-cuts—one at the depth of 82 feet from the surface, connecting with our adit level, to ventilate the mine, carry off water, and for other mining purposes: this cross-cut is driven 90 feet. At a distance of 120 feet south-west of where the last-named cross-cut communicated, I have driven 18 feet across the lode. Here I discovered magnificent specimens of yellow sulphuret.

About midway between these cross-cuts I met with a "horse" of arsenical rock, which divided the bed of black ore—one part rising to the top of said horse, and the other part continuing its course under the "horse," where the ore is very rich.

At this point I have commenced to sink a winze, in order to ventilate our level below; the winze at present is 30 feet in depth. I had to stop it in consequence of water, but shall resume again immediately, as the water is much easier. At this point the lode looks very promising.

At the depth of 142 feet from the surface, or 60 feet below our adit level, I have another cross-cut of 64 feet, at which point I have cut the lode, where we have a fine bunch of yellow sulphuret exposed to view. I have not as yet struck the foot wall. The further I get in the lode, the better it proves to be. I am at present in the lode five feet; if it continues to improve, it will surpass any thing I ever saw.

A new shaft is commenced at a distance of 200 feet from the engine shaft; it is now down 42 feet. This is to prove the lode and ventilate the mine.

I have erected a horse engine, which works two lifts of pumps of 8 inch diameter. I fear this mode of pumping will not answer long, as the water is considerably increasing.

I have also erected a whim of 10 feet drum, to raise the ore and dirt from engine shaft. I have made an inclined plane with double track, to convey the ore from engine shaft to ore shed. Ore of a rich quality is going over it rapidly.

I have from 4,000 to 5,000 tons of ore at present exposed to view, of different qualities, without taking any account of the yellow sulphuret.

Hiwassee Mining Company.

Account of Ore Sold and Delivered for the Year ending May 9th, 1855.

Boxes.	Tons.	Value.
9879	2034+	150,083.06

LAKE SUPERIOR REGION.

The following remarks on the Ontonagon district in particular, and the copper region in general, present some facts which exist in other parts of the country also. The severe trial which the mining interest has undergone will ultimately produce the best results. The Lake Superior country has not escaped this ordeal.

Three mines in the Ontonagon district alone, will be added to the dividend paying list during this year, the Toltec, the Forest, and the Norwich, and from Keweenaw point one or two others may be added to the list; the particulars of which we will give in our next number.

It is true that much more has been done among the mines here than could have reasonably been expected. All have found more copper than had been

anticipated. More has been shipped to this port than usual, notwithstanding the depression of the money market.

A due regard to economy had not been pursued by those most largely dealing in copper stocks, for they have been governed in their operations by a *speculative* spirit, rather than by the desire to *realize from the mine* in which they invest.

The idea of suddenly acquiring wealth rather than safe and profitable investments, has influenced those who have operated here, more than any thing else.

No portion of the United States can furnish the same amount of wealth with equal investments, as the copper region of Lake Superior. Money has been wanted here, but experience now shows that economy can do better.

We have passed through seven months of severe trial in regard to monetary affairs, and of course accompanied, in this far off region, by retrenchment and pecuniary difficulties that none below, not experienced, can appreciate; and notwithstanding all these depressions, our mines are paying well, and being developed in a manner to encourage the best anticipations.

We have arrived at that stage in which some decided opinion must be formed of the mines on this lake, and nothing tells better at such a crisis than figures.

We have in our last issue given the amount of copper in the Ontonagon district at 1,100 tons, equal to $334,000 when smelted, and in the shape of ingot copper. In the other portions of the copper region, Keweenaw Point and Portage Lake, 960 tons have been raised, worth when smelted, about $243,000; and at the same time, much ground has been laid open, and made available for the production of copper during the coming summer.

Alluding to these embarrassments at an earlier period of the season, it was stated by the *News:* that of the one hundred and twenty copper mines opened along the south shore of the lake, several, on which from $50,000 to $100,000 have been expended, have not become remunerative, and operations have therefore been suspended on them until a change in monetary affairs will warrant a resumption.

As the expense of putting a copper mine in a paying condition is from $75,000 to $100,000, besides the cost of location, it will be seen that this business has absorbed an immense amount of capital. Taking only the minimum given, $75,000 for each, the gross amount absorbed would be $9,000,000. The amount actually absorbed is probably much greater, ranging between ten and twelve millions. This is a pretty respectable sum to be hidden away in a remote corner, dependent upon the success of mining operations; but it shows how abundant was the enterprise which characterized the recent expansion, and how our people went neck and ears into all sorts of adventures, as though under the delusion that they had inexhaustible amounts of capital at their command. That this particular investment will ultimately prove of lasting benefit to the country, there cannot be a reasonable doubt; for the Lake Superior copper mines are really stores of wondrous wealth. But the hazardous nature of mining investments is well known; and however prolific the mines be, they require skilful management and great perseverance to make them pay a profit. Who can tell the fortunes lost and won in developing the coal treasures of Pennsylvania? It has long been a proverb in this region, that the party first opening a coal mine must fail of necessity, and that the profits will only be made by the next possessor. Yet who would now decry this source of untold prosperity, which has caused towns and cities to spring up almost by magic, covered all eastern Pennsylvania with a network of railways, and filled the harbor of Philadelphia with the sails of a commerce greater in tonnage than the whole foreign commerce of New York? What coal is to Pennsylvania, copper is destined to be to the Lake Superior region.

SHIPMENTS OF COPPER.

Lake Superior Journal states that the shipments for the present season have already amounted to 814,764 pounds. The other shipments to come forward will add over twenty-five per cent. to the above. This is all the product of the past season. The amount is expected to be greatly increased during the present season.

PRODUCT OF COPPER IN SOUTH WESTERN VIRGINIA.

We publish below an official statement of the amount of copper received at the Lynchburg depot of the Virginia and Tennessee Railroad from the mines of Carroll county, from the 31st December, 1854, to the 1st July, 1855. When we bear in mind that those mines were first opened, but a little more than six months ago, this statement is truly an astonishing one. The receipts far outstrip the calculations of all those who were best acquainted with the resources of the Southwest, and who were most sanguine as to the results of the mining operations in copper.

Copper Ore received at the Lynchburg Depot from the Carroll County, Virginia mines, to 1st July, 1855.

Date.	From what mines received.	Boxes.	Pounds.
1854.			
Dec. 31.	Jno. G. Stewart & Co.	102	50,422
1855.			
Jan. 31.	do.	57	24,596
Feb. 28.	do.	99	58,297
Mar. 31.	do.	177	90,334
		435	220,649
1855.			
Jan. 31.	Meigs' Copper Mining Co.	229	104,023
Feb. 28.	do.	247	140,939
Mar. 31.	do.	549	288,707
April 30.	do.	88	50,872
		1,113	584,941
1855.			
Jan. 31.	Cranberry Mining Co.	100	64,273
Feb. 28.	do.	151	97,301
Mar. 31.	do.	84	17,432
April 30.	do.	13	7,422
May 31.	do.	133	102,030
June 30.	do.	93	50,666
		574	339,124
1855.			
Jan. 31.	Pierce & Co.	13	9,170
		13	9,170
1855.			
Jan. 31.	Dalton Copper Mining Co.	10	4,890
Feb. 28.	do.	46	25,236
		56	30,126
1855.			
May 31.	Wild Cat Mining Co.	176	90,800
June 30.	do.	126	64,024
		302	154,824
1855.			
May 31.	Ann Phipps' Mining Co.	82	39,432
June 30.	do.	56	22,518
		138	66,950
1855.			
June 30.	Fairmount Copper Mining Co.	90	49,984
	Total	2,721	1,454,363

ON THE FORMATION OF BRASS BY GALVANIC AGENCY.*

Copper is more electro-negative than zinc, and separates more easily from its solutions than a metal less negative. If, then, in order to obtain a deposit of brass by galvanic means, we employ a solution containing the two component metals, copper and zinc, in the proportions in which they would form brass, there will only be produced by the action of the battery a deposit of real copper; the zinc, more difficult of reduction, remains in solution. What must be done, then, to obtain a simultaneous precipitate of the two metals in the proportions required, is either to retard the precipitation of the copper, or to accelerate that of the zinc. This may be effected by forming the bath with a great excess of zinc and very little copper.

Dr. Heeren gives the following proportions as having perfectly succeeded:

There are to be taken of	Sulphate of copper,	1 part.
	Warm Water,	4 parts.
And then	Sulphate of zinc,	8 "
	Warm water,	16 "
	Cyanide of potassium,	18 "
	Warm water,	36 "

Each salt is dissolved in its prescribed quantity of water, and the solutions are then mixed; thereupon a precipitate is thrown down, which is either dissolved by agitation alone, or by the addition of a little cyanide of potassium: indeed, it does not much matter if the solution be a little troubled. After the addition of 250 parts of distilled water, it is subjected to the action of two Bunsen elements charged with concentrated nitric acid mixed with one tenth of oil of vitriol. The bath is to be heated to ebullition, and is introduced into a glass with a foot, in which the two electrodes are plunged. The object to be covered is suspended from the positive pole, whilst a plate of brass is attached to the negative pole. The two metallic pieces may be placed very near.

The deposit is rapidly formed if the bath be very hot; after a few minutes there is produced a layer of brass, the thickness of which augments rapidly.

Deposits of brass have been obtained in this way on copper, zinc, brass, and Britannia metal: these metals were previously well pickled. Iron may, probably, also be coated in this way; but cast iron is but ill adapted for this operation.—*Mittheilungen des Hannov. Gewerbevereins*, through *Bulletin de la Société d'Encouragement*, *No.* 16, *August*, 1854.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

WYTHE UNION LEAD MINES.

These mines are located on New River, 16 miles from Wytheville, Virginia, and are owned and worked by a company. The lead ore is gotten out of a high hill near the river. It is washed and smelted at the works immediately on the river, whose machinery for lifting water, crushing the ore that is blended with rock, and keeping up the blast, is worked by water, the river there having a fall, and being also dammed to give this power.

The ore occurs in a silicious limestone, generally of a white or gray color, though sometimes blue. The veins are irregular in dip and direction, frequently turning abruptly and sending off leads or branches. On either side of the ore,

* From the London Artisan, February, 1855.

the enclosing material is soft; on the upper side of the vein is generally a reddish clay, while the bottom is firmer, containing crystals of phosphate of lead. The vein proper is generally 12 inches thick, and yields: compact sulphuret or blue ore; compact carbonate or gray ore; crystallized carbonate or cat's tooth; carbonate and oxide, brown and red; and finely divided sulphuret or black ore; (according to Rogers, William B.) The blue ore occurs in irregular masses or cups. The yield of the rough ore from the mines is estimated at 50 per cent.

A horizontal shaft has been wrought into the side of the hill from the plain below, at great expense; but it struck below the lead veins. A perpendicular shaft has been sunk to it, a distance of 225 feet from above, and used as a Shot Tower. The shot are conveyed along the horizontal shaft (to which they fall in making) by a railway.

A great many shafts have been sunk in getting out the ore—the veins being so irregular. These are all distances from 20 to near 200 feet deep. It is strange that the ore is raised chiefly *by hand.* A like primitive system prevails at the works, where a great many processes easily adapted to machinery, are still laboriously performed by hand. The sweeps at the buddles or vats, for washing, are worked by hand.

The ore in the vats of running water is rapidly disengaged from the earth, and the heavier particles settling to the bottom, the layers, according to *weight*, are as distinctly marked as could be. The operative scales off each and separates it. The coarser ores blended with stone, have first to pass through the crushers, which are grooved rollers fitting into each other.

These works produce about 500 tons of lead per annum, which is wagoned across the country eight or ten miles to the Virginia and Tennessee Railroad, at Mack's Meadows, where it is put on the train for market.—*Richmond Dispatch.*

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE for 1855.

Shipments by Railroad to July 12th	1,195,516.08	tons.
" " Canal	474,340.03	"
Total	1,669,856.11	"
Same time last year	1,463,827.08	"
Increase	206,029.03	"
Lehigh Coal Trade to July 7th	479,499.08	"
Last year	418,489.09	"
Increase	61,009.19	"

WYOMING COAL TRADE to July 7th.

Pittston	57,901	"
Wilkesbarre	57,395	"
Plymouth	20,289	"
Nanticoke	21,735	"
Total	157,320	"

CUMBERLAND COAL TRADE to July 7th.

Total	285,717.00	"
Same period last year	262,459.00	"
Increase in 1855 so far	23,258.00	"

HOW COAL MINES ARE WORKED.

A correspondent writes us as follows:—Coal land owners in the Pottsville basin do *not* generally work their own mines, and the few companies whose charter allows them to own lands, and erect machinery, are not allowed to mine coal. Parties (technically called "operators") lease particular tracts, or veins or portion of veins, either above or below water level, at a rent per ton of the coal mined, which quantity is ascertained by reference to the books of the weigh masters of the lateral Rail Road Companies. The price per ton varies from 20 cts. to 60 cts. per ton, dependent on the ease with which the Coal can be mined, its value in the market, its proximity to the outlets. The toll on the Mine Hill Rail Road, for example, being per ton 2½ cts. per mile, it follows, that if a certain vein can be leased for 30 cts. right from the scales, the operator will be willing to pay for an equally advantageous mine, two miles nearer (for which the toll is five cents less), 35 cents per ton.

These leases are for such times as may happen to be satisfactory, and it is generally stipulated that a given quantity of rent shall be paid, in order to ensure the efficient working of the mine.

CAPACITY OF A SINGLE AND DOUBLE TRACK.

Over a single track can be transported a quantity dependent on many circumstances; such as the number and nature of its laterals, the skill of its superintendent, &c.. As a maximum may be put 2,000,000 per year.

On a double track can be transported twice as much as on a single, and such is always laid when business reaches to a considerable magnitude.

COAL FREIGHT ON RAILROADS.

Freight per ton on Reading Rail Road, 93 miles continuous, about 2 cents charged per mile—actual cost ½ cent, on shorter laterals 2½, except there be expensive planes as on the Ashland extension Rail Road, where 3½ cents are charged. These prices yield a great profit to the Rail Road Company's capacity.

COST OF MINING COAL.

Cost of mining coal varies greatly: it may cost in one place, four times what it does in another, owing to the difference between coal being above or below water level—being in thick and pure veins, or in thin and faulty seams, &c., &c. At the present low prices of $2.00 2.37½, there is but little profit in mining. At last year's prices of $3.25 to 3.75, there was much to be made.

The price of coal is always fixed to be delivered on the Main or Reading Rail Road, or into the canal boats, the operators paying the lateral Rail Road tolls.

CONNECTION OF THE SCHUYLKILL COAL REGION WITH NEW YORK.

We learn that Ellwood Morris, Esq., Engineer and Superintendent of the Dauphin and Susquehanna Railroad, has been reconnoitering the route for a railroad from Auburn to intersect the Lehigh Valley Rail Road at Allentown, leading directly to New York. Mr. Morris has discovered a route by which a road can be made from Auburn to Allentown, a distance

of 38 miles, with a grade not exceeding 16 feet to the mile running East, and 32 feet running West. By this route Pottsville would be brought within a distance of 140 miles of New York City—and the road can be made at a cost of about $1,200,000, and for $2,000,000, fully equipped for a large business. The following are the distances:

	MILES.
Pottsville to Auburn,	10
Auburn to Allentown,	38
Allentown to Easton,	17
Easton to New York,	75
Total,	140

By this road the whole Coal Region of Schuylkill County will have access to the New York market by railroad direct—and as this is the most direct route from New York to the great West, being almost an *air line*, as the maps will show—we feel confident that the road will be made forthwith. The Report of Mr. Morris will be issued in a few days.—*Pottsville Journal.*

JEANESVILLE, LUZERNE COUNTY.

The mining town of Jeanesville is on the borders of Luzerne, Carbon and Schuylkill counties. A few years ago and it was all a wilderness, rich in "*Black Diamonds*" but covered in the earth. Mr. Wm. Milnes, the pioneer on this track, leased the Beaver Meadow Mines, and commenced earnest and active operations to develope the vast resources of this valuable tract. Since then several improvement have taken place in and around the immediate neighborhood. The German Company; the French Company—by the way this company has, as yet, made but very little progress, working in a manner that was supposed to be tolerably well some twenty-five or thirty years ago. Using hand-breakers and hand-screen and not one single appliance of modern steam improvements, which for near seven years' operations must be admitted as being but small—they having, as yet, but shipped something like 200 tons of coal. Then we have the York Company, and the works opened by the late and truly lamented Mr. Cleaver. Since the disastrous freshet of some five years ago, the Beaver Meadow Rail Road Company has wonderfully advanced both in its efficiency and its market value. For several years it appeared as though an incubus rested on all connected with it. In its darkest and most trying hour Mr. Milnes, though not directly connected with the interests of the road, lent it his *moral* and *material* support—all of which the worthy President of the Company, Mr. Longstreth, fully acknowledges. From its stock being at a ruinous discount, it is now quoted on "change" as *par* a *premium*. For some time the planes to Weatherly were found fully adequate to supply the necessary transportation—but since the Hazleton Company built their new road to Penn Haven, the Beaver Meadow Company have bought their old road, which will enable them to avoid the planes and so facilitate their transportation. The new road and three new engines are promised to be in full operation some time this month. Down in Weatherly everything wears a business look; the machine shops in full employ; new car shop, all in active operation.

We see too that at last (though we scarcely expected) Mr. Cox has opened on his tract near Beaver Meadow.

The improvements in Jeanesville are extensive and permanent. We have here six slopes; a shaft and tunnel; a new machine shop and foundry, and a large boiler shop. In addition to which Mr. Milnes is now sinking another slope which is fully believed will command two million tons of the first quality coal. There are now one hundred and fifty tons of coal shipped from here a year. Shipment is seriously curtailed for want of more efficient means of transportation, but the direct communication to New York via Easton will open another avenue, and the amount of coal shipped from this one operation will be very large. The engines, boilers, and other apparatus for the new slope are in a state of progress.—*Correspondence, Record of Times.*

BITUMINOUS COAL TRADE OF PENNSYLVANIA.

On this subject, the *North American* furnishes the following interesting facts:—

THE BITUMINOUS COAL TRADE OF PENNSYLVANIA has, for many years past, been growing up quietly into much importance, though, as the energies of Philadelphia have been chiefly devoted to the anthracite trade, the progress in the bituminous mines has been but little known here. Latterly the development of an extended railway system has been tending to put us into a more intimate connection with all the mineral treasures of Pennsylvania, and probably the time is fast approaching when, by means of the Pennsylvania, Sunbury and Erie, and North Pennsylvania Railroads, and their branches, we shall make Philadelphia the focus of the entire mineral trade of the State. As yet, the great Pennsylvania Central Railway has not done any coal business; but a beginning is about to be made by means of the connection opened with the Broad Top mines. These are said to be most prolific, and promise, when fully worked, to increase very largely the coal trade of Philadelphia. In quality the coal itself is described as resembling that of the Cumberland mines, the product of which has, of late years, increased so rapidly. We do not apprehend that it can ever come into serious competition in the same markets with our anthracite, for domestic purposes, but as the demand for the latter has increased far beyond the supply, in consequence of the rapid multiplication of people, there is a fair field for our own bituminous and semi-bituminous coals to supply factories, steamboats, etc. Practically these Broad Top mines are as near to tide water at Philadelphia as are those of Cumberland to tide water at Baltimore, and therefore the same reasons which have operated to swell the product of the Cumberland mines ought to cause an equal prosperity for the trade of the Broad Top region. During the year 1853 the product of the Cumberland mines was 538,980, and in 1854 the shipments exceeded 600,000 tons. The increase of this trade has no doubt been stimulated by the facilities offered by the Baltimore and Ohio Railroad for conveyance to market, as of the whole amount shipped from the region in the year 1853, the railroad carried 376,220 tons. Up to the present time the Broad Top mines have been without any railroad facilities, but as a railway from the mountain, to connect with the Pennsylvania Central, is now nearly completed, we may expect a speedy development of the wealth of the region. It would not require much of an extension of the Broad Top Railway to reach the Cumberland mines, and so put Philadelphia in direct communication with the vast stores of mineral wealth found there. If the Pennsylvania Railroad were desirous of seeking this rapidly increasing trade, it might be obtained without much outlay, and added to the Broad Top coal trade, would prove of immense profit, not merely to the main road, but to Philadelphia.

CUMBERLAND COAL COMPANY.

The recent Report of the President, A. Mehaffey, to the Stockholders, is as follows:

In presenting to you this Report of the Financial Condition of the Company, and its operation during the past fiscal, and first year of my connection with it, and the third year of its existence, I have it in my power to congratulate you on what, under all the circumstances, may be considered a favorable result.

There was mined and sent to market during the year 225,208 tons of coal, which, after deducting expenses for mining, transportation, agencies, salaries, rents, commissions, insurance, &c., netted $189,630 68, which, together $29,700 23 net freights received from Company's vessels, amounts in the aggregate to 219,330 91. The quantity of coal sold would have been greatly increased, but for the sudden check caused by an almost complete suspension, in

the past six months, of the various manufacturing establishments, some of which have partially and others fully resumed. This temporary falling off has, however, been more than counterbalanced by the increasing demand for steam and locomotive purposes, and the greatly augmented list of a new class of purchasers. The superior quality, and the economy of this coal for steam and manufacturing purposes over that of *any* other, is, after the most thorough practical tests, universally admitted.

It is now used, to the almost entire exclusion of any other fuel, on the freight and passenger engines on the Baltimore and Ohio Road; also, on the Northern Central, more generally known as the Baltimore and Susquehanna Railway, where wood can be purchased at $3 per cord; and within a recent date, a most remarkable proof has been furnished of its adaptation to this purpose on some of our eastern roads; so much so, that a large establishment at Taunton has commenced the manufacture of locomotives for the use of our coal, and others are turning their attention to the same object. Two engines have been working on various roads during the past year with remarkable success; one of them having ran more than 20,000 miles with invariable economy, as per experiment on Boston and Lowell road, showing a saving of 52 per cent. in favor of Cumberland coal.

That the use of this coal, within a very brief period, will be as general on our railroads as wood now is, there cannot be a doubt; so rapidly is it gaining in favor, that its increased consumption for the *last five years is* 88 *per cent. against* 18 *per cent. of anthracite.* It may here be remarked, that on one road, the Hudson River, there was consumed, in the past year, 40,000 cords of wood, costing the almost *incredible* sum of $280,000. Cumberland coal, to generate the same quantity of steam and perform the same amount of labor, would have cost not exceeding $160,000, thus showing a saving of 120,000, being, at 6 per cent., the interest of $2,000,000, a sum *well worthy* the attention of the Stockholders of that and other roads using wood as a fuel at very high cost, and the expense of which must increase in each succeeding year.

A large expenditure was incurred in the early part of the past year with a view to a greatly increased business (which has been unfortunately checked by causes already referred to), in the purchase of locomotives, iron Hopper cars, erection of engine house, building canal boats, renewal of main track, extension of tram roads, substitution of iron for wooden pipes to convey an ample supply of water for use of locomotives, and in adding to the facilities for dispatching coal, whereby its cost, delivered at Cumberland, has been greatly reduced.

All these improvements are of a permanent character, and with the single exception of a renewal of a portion of the main track, close the "Construction Account" for many years to come. In this connection it may be proper to remark, that every facility has been afforded by the Baltimore and Ohio Railroad, and Chesapeake and Ohio Canal, both under energetic management—the latter, not inferior to any similar work in the United States, is deserving special notice, from the fact of its remaining in perfect order since the opening of navigation, owing mainly, it is believed, to the untiring energy and faithfulness of the General Superintendent, Mr. Stake, who is now, under a resolution of the Board, erecting at the south branch of the Potomac two steam-pumps, to be completed by the first of July, and which will ensure a full supply of water in the dryest season.

The available assests in hand, after deducting $112,755 83 suspended debts existing at the time I assumed the duties of the office, amount, as per statement annexed, to $156,294 05, which it is the interest of the Company to retain as *working* capital.

Of the three principal mines fully equipped, with all the necessary buildings, tools, means of transportation, &c., one only is now regularly worked. Although a large amount of capital is thus rendered inactive, experience has shown that either one of them is amply sufficient for the business of one company for a long period of time, and economy has already justified the course adopted.

In January, 1853, the debt of the Company was $825,000, and at the commencement of the past year it was $537,000, the interest of which has been paid; and seventy thousand dollars (70,000) of the principal has recently been extinguished by paying off and cancelling the bonds, leaving a balance of $467,000, which will fall due on the first day of January next, and may be provided for without embarrassment to the Company, which is now earning large returns on the property *actually* worked. The mines, with their perfect equipment of buildings, tools, and facilities for transportation, are of immense intrinsic value, and afford full and ample basis for an almost unlimited amount of business, and I would therefore suggest the propriety of augmenting the resources and facilities of the Company, by disposing of such portion or portions of the property as are unnecessary for its profitable and successful business.

It is believed, however, that the increasing value of that portion of the property undeveloped is more than equal to the deficiency in revenue. Still, as *immediate* and regular semi-annual returns are desired, the remedy is, as already suggested, in disposing of portions of the land; or, if preferred, leasing on royalty, or both.

I called your attention some months since, by circular, to the analysis of iron ore discovered on the Company's lands; encouraged by subsequent tests, I have ordered a large quantity of the ore to be smelted in a blast-furnace engaged for the purpose, in all of next month. Should the result prove satisfactory, it is not doubted by *competent* judges who have investigated the subject, that with the exhaustless quantities of ore, coal and limestone in close proximity, and of easy accessibility, pig and railroad iron can be produced and delivered at tide-water, at less cost than from any other locality.

As an evidence of the increasing demand for our coal, I would state, that we have sold, in the months of January, February, March, April and May last, although at less remunerative rates, 66,862 tons, against 50,709 tons in the corresponding months of last year.

In conclusion, I would state, that on my accepting this office, I invited the Stockholders to come and examine into the business and transactions of the Company. I again solicit the exercise of that right and duty, before giving credence to any casual report calculated to depreciate the value of your property.

All of which is respectfully submitted.

A. Mehaffey, Pres't.

Statement of Assets, C. C. and Iron Co.,

May 1st, 1855.

Assets, May 1st, 1854		$269,720 33
Net earnings, May 1st, 1855		219,330 91
		489,051 24
Paid for locomotive, cars, canal boats, engine house, &c.	$40,654 85	
" Railroad iron, renewal and extension main track and tram roads	28,631 32	
" Wharf at Alexandria, re-building schooners, barges, &c.	83,544 89	
		152,830 06
		$336,221 18
Suspended debts	112,755 33	
Paid for 35 bonds	33,250 00	
		$146,005 33
		190,215 85
Personal and indispensable property at the Mines, Alexandria and Baltimore		33,921 80
Available assets in cash and bills receivable on hand, May 1, 1855		$156,294 05

2822 shares of the Capital Stock belonging to the Company.

COAL TRADE OF CLEVELAND, OHIO.

The coal trade of Cleveland, which is just in its infancy, may be said to have commenced in 1830, with the sale of 5,100 bushels. In 1840, it amounted to 167,000 bushels. In 1850 the supply amounted to 2,347,844 bushels, and in 1854 to 7,000,000 bushels, in round numbers. In no year since 1838 has the supply of coal tributary to the lakes been commensurate with the demand. From a careful inquiry into the consumption in all the principal lake markets, it is manifest that the quantity of coal consumed could have been increased from 40 to 50 per cent. had coal been furnished to consumers, particularly at retail, at such minimum prices as would have given those engaged in its production, transportation and selling, living profits—more particularly in the cities of Buffalo and Chicago. Instead of minimum, or even medium prices, coal has ranged at the maximum famine figures, sufficient to exclude it as fuel from the houses of the poor and middling classes; while the rich, many of them, abandoned its use and returned to wood. Even steamboats and manufactories were compelled to use it sparingly.

The receipts of coal in Cleveland, by canal and railroad, from 1840 to the present time, are as follows:

	Bushels.		Bushels.
1840	167,045	1848	1,925,451
1841	479,441	1849	1,910,474
1842	466,844	1850	2,337,844
1843	387,844	1851	2,992,848
1844	560,842	1852	3,910,749
1845	889,880	1853	5,117,312
1846	893,306	1854	7,000,000
1847	1,238,622	1855 estimated	10,000,000

This rapid increase is fully equal to, if not larger than, that in the anthracite region, and shows the extent of the development of the coal interests of Ohio—only second to Pennsylvania, not only in the production of coal, but in the manufacture of iron. The quantity actually shipped in 1854 was: down the Ohio River 583,000 tons; to Lake Erie 257,000 tons—total, 840,000 tons. The whole number of bushels shipped within the past ten years from Cleveland, has been 135,000,000, sufficient to exhaust some of the earlier beds opened, and to bring others to yield a poor and inferior coal, and also to jeopardize the permanency of many others.

This brings us to the inquiry, where shall we look for the future and permanent supplies to meet the great and increasing demand for mineral fuel? Cleveland, hitherto, has been supplied from the outliers of the great Apalachian coal field, consequently there has been a failure to meet the demand from this precarious source. The outliers of all great coal fields are alike uncertain and treacherous. This failure will increase more and more in years to come. There is no other remedy but to seek a supply from sources nearer the centre of the basin.

If we examine the physical geography, as well as the geological features of this basin, we shall find that near the divisional line of the counties of Columbiana and Jefferson, the Ohio River makes its nearest approach to the waters of Lake Erie in its great northwestern detour to the south and southwest. The Cleveland and Pittsburg Railroad, in its course to the Ohio River, strikes the north fork of Yellow Creek, a small tributary at the village of Salineville, in Columbiana county, and follows it down the valley the distance of twelve miles to its confluence with the Ohio. Through the whole distance it reveals rich and productive seams of coal. It is easily demonstrated that in no other part of the Apalachian coal field does any other road penetrate a valley with seams of coal of so rich and varied qualities, and withal so easily reached by railroad facilities, and at the same time so contiguous to the great coal market of the northwest.

The following are the cargo prices of the different kinds of coal, with the sources of supply:

BROUGHT OVER CLEVELAND AND PITTSBURG RAILROAD.

	Per ton. 2,000 lbs.		Per ton. 2,000 lbs.
From Pittsburg, Pa.	$4 25	From Darlington, Pa.*	$4 25
Cumberland, Va.	3 75	Linton, O. River	3 50
Diamond Y. Creek	3 50	Hammondsville	4 00
N. Salisbury	3 50	Salineville	3 25
Tuscarawas Co.	3 50		

BROUGHT BY CANAL.

From New Castle, Pa.	$3 25	From Briar Hill, Ohio	$4 00
Mahoning, Ohio	3 75	Chippewa	3 75
Talmage, "	3 50		

SEWANEE MINING COMPANY.

The property of the Sewanee Mining Company is situated in Franklin and Marion Counties, State of Tennessee, and comprises 17,950 acres of land in fee, and the mineral rights and right to use timber, to 3,780 acres.

The Company was formed for the purpose of supplying with coal that section of country lying between Charleston, South Carolina, and Savannah, Georgia, on the sea coast; and Nashville, Tennessee, on the West; the communication between these points being perfected by direct lines of railroads, more than 800 miles of which are now in operation, besides a great number of lateral roads.

To effect this purpose, it was necessary to construct a railroad *nineteen miles* in length, to connect the Company's *great deposits of coal* at the "*Wooten*" Mines, with the Nashville and Chattanooga Railroad.

These inexhaustible deposits of coal, owing to their surface exposure on the hill sides, can be worked at a small cost and *without machinery*, by horizontal galleries, now open, entering at a level with the Company's railroad. The coal is bituminous, of a quality equal, if not superior, to the best Cannel Coal, and is admirably adapted for the manufacture of gas and steam, and for furnace and household purposes.

Nine miles of the Company's road are completed and in operation to the "Porter and Logan" Bank, a comparatively small deposit of coal, which is now being sent for consumption to the city of Nashville.

Nashville lies 87 miles west of the junction of the Sewanee and Nashville and Chattanooga Railroads, and contains a population of between 30 and 40,000 souls; its supply of coal has hitherto been very precarious and insufficient, depending entirely upon the stage of water in the Ohio and Cumberland rivers, which are unnavigable during one half of the year, and during the remaining half are often greatly obstructed by ice. During the past winter, owing to an insufficiency of water in the rivers, very small supplies of coal reached Nashville; this coal sold as high as $12 *per ton*, and was entirely inadequate to supply the demands even at that price.

Nashville consumes at least 30,000 tons of coal per annum, which will be largely increased so soon as reliable and full supplies can be obtained. The coal can be delivered at Nashville at a cost of two dollars per ton (*the maximum*) including the expenses of mining and freight—a favorable contract having been made with the Nashville and Chattanooga Railroad Company for the transportation for a term of years.

The City of Augusta, 378 miles east from the Sewanee junction, has a population of 20,000, and is without any supply of coal; in view of that to be furnished by this Company, responsible parties have already offered to contract for 50,000 tons per annum; and the Etowah Iron Manufacturing Company, on the route to Augusta, alone require 10,000 tons per annum, which they are desirous of obtaining from this Company.

* Cannel.

The large towns and villages, of less note than those named, on the lines of road between Nashville and the sea-board—in number more than one hundred and fifty—will consume large quantities of coal, and can have no other certain and cheap source of supply than that offered by the Sewanee Company.

The rich and extensive copper mines in Polk County, Tennessee, distant from the coal mines 181 miles, when connected therewith by railroad, of which a link of only 37 miles now remains to be built, will require large quantities of coal for the reduction of the ores (more than 6,000 tons during the past year having been sent to the Eastern States and to England), and the manufacture of iron from the inexhaustible deposits of ore which exist throughout the adjacent country, will become an important branch of industry so soon as a supply of coal can be obtained.

The Directors are satisfied that, upon the completion of their railroad, they can easily dispose of from 150 to 200,000 tons of coal per annum, at a largely remunerative price; and the demand constantly increasing with the advance of the country in population and manufactures, must make this business one of unfailing profit to the Company.

In addition to the coal fields, another important resource presents itself in the luxuriant growth of timber which covers the entire property of the Sewanee Company.

The consumption of lumber at Nashville is estimated at more than 6,000,-000 feet per annum, of which 3,200,000 feet are consumed by five of the principal carpenters and builders, at a price never less than $12 per M feet; a liberal allowance for sawing, transportation, and other expenses would be $8 per M feet, leaving a profit of not less than $4.

The market for this article is not limited to the city of Nashville; lumber is equally scarce in all parts of the State of Tennessee, and the price equally high.

A VISIT TO THE COAL MINES IN LASALLE CO., ILLINOIS.

It seems a little strange, but by accident or some other cause, we took our way from the city on Wednesday last, in company with one of our citizens, and after riding over a portion of the roughest road we have ever had the opportunity of seeing in this section—the unevenness of which is attributable to the recent rains—we soon found ourselves in the immediate vicinity of the coal shaft, about one mile or a mile and a half from our office.

After taking a glancing survey of the surrounding lands, and imbibing a liberal quantity of pure spring water, which had just been taken from the earth by one of the several workmen, near Split Rock, we divested ourselves of coat and hat—at the same time rolling our pants up to the straps of our boots, and putting on an old pair of overalls and cap—the latter we examined carefully—proceeded towards the opening of the pit.

On entering, for the first few rods, we walked in an upright position, but as we proceeded it was necessary to contract our bodies gradually, until our knees and chins became very near neighbors, and our overalls licked up the mud with impunity, which seems to be characteristic of the miners' clothing.

The ceiling above the coal in some places is made up of strong, solid rock, and appears as substantial and enduring as time itself, while in other places it consists of blue clay, which looks ugly in spots, and by the action of the air upon it caves off at intervals, and is then taken by the miners and thrown into the chambers from which the coal has been removed.

Means are being adopted to work this mine on a very extensive scale. It lies within a few rods of the Chicago and Rock Island Railroad, and the Illinois and Michigan Canal, so that coal of any amount may be taken from this mine and meet with ready means of shipment.

The proprietors intend developing this mine to its utmost productive capacity. An excellent idea we should think. Its close proximity to the rail-

road and canal must give it some very important advantages over some of the other mines. During the summer season, coal can be shipped at very low tariff on the canal and river, and in the winter or season during which these are closed, the railroad is equally as accessible, though at a higher price for transportation. Thus we see this mine is in a good location.

An embankment is being built for the purpose of laying a side track, to connect with the road, of sufficient length to allow of five or six freight cars being loaded at the same time without being annoyed by the passing trains. And we also observe that Messrs. FIELD & ROUNDS, the proprietors, are making arrangements to weigh all the coal shipped from this mine, by erecting one of Fairbanks' Patent scales, with power sufficient for weighing three thousand pounds. This will avoid all mistakes which usually occur from selling without regard to weight, and purchasers will receive in weight what they contract for.

The coal taken from this mine is of superior quality, this, however, is characteristic of the most of the coal located in this vicinity.

Before many weeks, we shall refer to this shaft, again, in connection with several others which are now being opened, when we will endeavor to present the correct amount realized from the different diggings, and the relative superiority of the coal.—*Lasalle Journal.*

A CALIFORNIA COAL MINE.

If all the coal mines on the Pacific coast discovered within the last five years prove to be really of the value they were originally announced, there will be abundance of the best qualities of the article for our steam marine and for manufacturing operations. In Oregon and California especially, many mines of coal, pronounced to be superior in quality and inexhaustible in quantity, have been at various times discovered and proclaimed with a great flourish. After the first excitement, we have heard very little respecting any of them, and we are at this moment in ignorance as to whether they have, on investigation, proved delusive, or are now worked. The last revelation of the kind is mentioned by the San Jose (California), Telegraph, and is called the Santa Clara Mine. It was discovered by a company of Frenchmen, and gives promise of great importance. The locality is given as twelve miles southwest of the town of San Jose, on a stream called Jones' Creek, and near Jones' Saw Mill. The Telegraph says that the French miners alluded to have been engaged for many months back in opening pits, and examining the quality and value of the coal beds. They have penetrated a considerable depth into the mountain, which is a part of the coast range, and have pursued a continuous vein of coal, varying in thickness from four to eight feet. As they go deeper the coal becomes freer from slate and other impurities.

One of the operators had exhibited to the editor of the Telegraph several samples of the coal, one of which was a piece a foot square. It resembles "cannel" coal, and burns freely and brightly. The land containing the coal belongs to Zeri Joaes, of San Jose, upon a title confirmed by the Land Commission, but the French company mentioned have secured a long lease of the mines, and purpose to work them energetically. Preparations are being made by boring to penetrate to the second stratum of coal, which in coal mines is usually of a richer quality than the first layer. Dr. Trask, the State Geologist, had, previous to this discovery, expressed opinions adverse to the existence of coal in the coast range, but the revelations we have described upset his scientific deductions. We have received a copy of Dr. Trask's report on the Geology of California, and on examination we find, that although the Doctor overlooked the coal indications near San Jose, he discovered coal-bearing rocks, of the true coal measures, in the northern part of the State, which he thus speaks of:

"The discovery of this group of rocks brings us in close connection with a new geological era within the State, and enables us to present the outline of

a strong hope that we may yet be able to discover that article of comfort and economy so much needed on these western shores. These rocks belong to the carboniferous system, and appear to be the representatives of that system developed during the survey of the northwest Territories by Mr. Owen. They appear almost identical with the superior portions of the 'Carboniferous rocks of Iowa and Des Moines,' and in which the coal measures are found. The coal beds probably lie in the high tables toward the base of Lassens' Butte, and the dip of the rocks to the east at an angle of about 20 degrees, and the elevation of the lands lying in that direction with their outline, would warrant extensive explorations in those quarters, with strong grounds for the belief that success would attend the search; while to the north the beds should be sought for among the higher hills and low mountains east of Shasta Butte, or perhaps as far north as the Siskiyou Range, beyond the Klamath River."

A late number of the Placer Times and Transcript, says that Dr. Trask's opinions have been verified by the recent discovery of three heavy seams of coal in the sections indicated by him, but as the Times gives us no information on the subject, we are left to conjecture of what description they may be.

COAL OR WOOD FOR LOCOMOTIVES.

The cost of running an engine with Cumberland coal, at $6 per ton, would be 10 cents per mile; with wood at $6 per cord, 21 3-4 cents per mile; thus it will be seen

that the cost of running an engine 30,000 miles with wood, would be	$6,525
Same distance with coal	3,000
Difference in favor of coal	$3,525

Performance of steam engine "Nebraska," on the Boston and Lowell Railroad, with wood and Cumberland coal, as per statement of account with H. Boardman, March 22d, 1855:

The whole distance run was 2366 miles.

The allowance for wood was as follows:

1768 miles run with freight, at 26 miles per cord, making 68 cords, at $7		$476 00
598 miles with passenger train, at 30 miles per cord, is 19·93 cords at $7		139 51
		$615 51
WOOD AND COAL.		
6 3-6 cords of wood at $7	$45 50	
33·84 tons coal at $8	270 72	
		316 22
Difference in favor of coal		$299 29

Statement showing the result of the above, putting coal at the wholesale price, say $6 per ton:

Cost of wood as above		615 52
WOOD AND COAL.		
6 3-6 cords of wood at $7	$45 50	
33·84 tons coal at $6	203 04	
		248 54
Difference in favor of coal		$366 97

Cumberland Coal Company's Report.

CONSUMPTION OF FUEL ON RAILROADS.

The Cincinnati Railroad Record has an interesting article on the consumption of fuel on railroads. We note a few of its facts. The following is the number of miles and the wood consumed on five railways:

	Miles.	Cords.
New York and Erie	460	65,000
Pennsylvania Central	253	27,000
Little Miami	184	16,000
Cincinnati and Dayton	60	10,000
Columbus and Xenia	54	7,000
	911	125,000

This is an everage of about 140 cords per mile per annum. The increase of business will require an increase of fuel. The writer says this consumption, with the quantity necessarily used for private and household purposes, will use up all the fuel on the lines of the roads in fifty years. The cost of wood on the Eastern roads averages $6 per cord; on the Western roads the estimate is $3 per cord. On all the roads of the Union the cost of fuel now consumed is estimated at eleven millions of dollars per annum.

The editor of the Record is of opinion that coal will soon be substituted for wood on the roads. The cost will be less even at present prices, and in a few years the difference will be still greater in favor of coal. The Little Miami, Columbus and Xenia, Cincinnati and Marietta, and Wilmington, Zanesville and Hillsborough lines, make together 468 miles, and consume 80,000 cords, at a cost of $240,000 per year. These roads, by the use of coal, can save $160,000 per year, which is the interest on two and a half millions of dollars.

BRECKENRIDGE COAL CO.

A letter from the mines of this Company furnishes the following important facts:

I have spent several days investigating the affairs of the Breckenridge Coal Company, and am happy to assure you that every branch of this magnificent enterprise not only equals but exceeds the most sanguine expectations of those interested in the Company.

The railroad running from the Ohio River to the mines, eight miles in length, is in excellent condition, and the Company are transporting coal in large quantities to the river, where it is sold or shipped to New Orleans and other markets on the Mississippi.

At the mines, the coal as it comes from the entrees in small cars is dumped through shutes into the railroad cars, and taken to the river by a locomotive of the most approved make for freighting purposes. At the river the Company have an inclined plane with two tracks; upon the plane is a movable platform, which can easily be drawn up or let down so as to adjust it to any stage of water. The outer portion of this platform projects over the boats. At the head of the inclined plane is a drum-house. Loaded cars are let down on one track, and the empty cars brought up at the same time on the other. The loaded cars run out over the boat, when the coal falls by the unfastening of a trap door. Thus you see the only handling of the coal is by the miner in loading his car in the mine. The Company are now loading 1,000 tons for the sugar plantations above New Orleans, which will be sent off in a few days. The agent of the Company in New Orleans is prepared to receive and forward to New York any amount that may go down the river.

The Company do not rely upon flat boats for transporting their coal, but have contracted for sixteen barges of 500 tons capacity each. Eight of these can be taken in tow by a steam-tug at a trip. The great advantage of the Breckenridge mines over any other coal property on the Ohio, or even on the Mississippi, is two-fold. 1st. Its superiority in quality, it being admitted by all to be twice the value of Pittsburg coal per ton for steam, sugar boiling, fuel, or gas. 2d. Its locality, it being 800 miles below Pittsburg and one hundred miles below the falls at Louisville.

From here to New Orleans the river navigation is seldom impeded by low water or ice. Nine months of navigation may safely be counted on, whereas three to four months is the average for Pittsburg.

The President, Mr. Pierson, has made a contract with an experienced man to mine the coal at a dollar and ten cents per ton; add forty cents per ton for transportation on the Eight Mile Railroad and for contingencies. Thus you see an article almost unlimited in quantity, and which readily sells at $5 per ton, costs the Company one and a half dollars on the Ohio River.

Bennettsville, where the Company's saw mill, car factory, and workshops are located, has already grown into a flourishing village of several hundred inhabitants, composed mostly of the employees of the Company and their families.

The President and two of the Directors are constantly here pushing the work with energy, judgment and economy, and everything as far as I am able to judge, indicates the most satisfactory results.

PORT RICHMOND COAL MARKET, JULY 18TH.

We quote White Ash at $4 25 to $4 87 1-2; Red Ash, $4 87 1-2 to $4 62 1-2 per ton on board.

NEW YORK COAL MARKET, JULY 12TH.

800 chaldrons Sydney sold at $5 50 cash. Anthracite sells at $5 25 to $5 50 by the cargo, and from yard at $5 50 to $6 50 per ton of 2000 lbs.

BOSTON COAL TRADE, JULY 11TH.

Cargo sales of Coarse Pictou and Sydney at $5 50 per chal., cash; retail sales of Anthracite at $6 50 per ton.

WHOLESALE PRICES.

Cannel	per chal.	10 50	to	12 00
Newcastle	do.	7 25	"	7 37
Orrel	do.	— —	"	— —
Sydney	do.	5 25	"	5 50
Pictou	do.	5 37	"	5 50
Bridgeport	do.	— —	"	— —
Virginia	do.	— —	"	— —
Schuylkill, white ash	per ton.	5 50	"	5 75
do red ash	do.	5 75	"	6 00
Lehigh, lump	do.	6 25	"	6 50
Lackawanna	do.	5 75	"	6 00

RETAIL PRICES.

Cannel	per chal.	11 00	"	— —
Newcastle, coarse	do.	8 00	"	— —
do. fine	do.	7 00	"	— —
Orrel	do.	8 00	"	— —
Scotch	do.	— —	"	— —
Welsh	do.	7 00	"	— —
Cumberland, run of pit	per ton.	6 50	"	— —
do. fine	do.	7 75	"	— —
do. coarse lump	do.	8 00	"	— —
Sydney	do.	7 00	"	— —
Pictou, coarse	do.	7 50	"	— —
do. fine	do.	5 00	"	— —
Lackawanna, lump	do.	7 50	"	— —
Lehigh, lump	do.	7 50	"	— —
White ash, lump	do.	7 00	"	7 50
Anthracite, white and red ash	do.	6 50	"	— —

IRON AND ZINC.

IRON MOUNTAIN REGION, MO.

The iron mountain region of Missouri is a spot of national importance.

Situated near the centre of the Mississippi Valley, about forty miles west of the river at Ste. Genevieve, and eighty miles south of St. Louis, the Iron Mountain, one of the spurs of the Ozark range, rising about 260 feet, and embracing

500 acres, is estimated to contain more than 200,000,000 tons of ore above its base; and its base is 628 feet above St. Louis directrix, and 1,000 feet above tide water in the Gulf of Mexico.

The Pilot Knob, another spur of the Ozark Mountains, six miles further south, rising like a cone 550 feet above its base, 1,088 feet above St. Louis directrix, and 1,460 above tide water of the Gulf of Mexico, embracing also about 500 acres, is capped on its summit by a vast body of solid iron ore, appearing from a distance like an immense black turreted castle.

The Shepherd Mountain, whose summit is nearly 700 feet above its base, adjoining that of the Pilot Knob, abounds with an ore which "is peculiarly adapted to the manufacture of steel of all kinds; it is one of the most valuable ores in Missouri, and fully equal to the Denamora ores of Sweden, from which the best English cast-steel is made."

Various other spurs of the Ozark, known as Pratt, Bogy, Christy, Shut-in, and Russell Mountains, all of which are within six miles of the Pilot Knob, abound with ores, most of which are of the first quality for making iron direct from the ore in the Catalan fire, the Bogy and Christy ores partaking of the same nature with the Shepherd Mountain ore, being very valuable for steel-iron.

The ores of this region are mainly specular oxide, and yield from sixty to seventy per cent. of pure iron, though large beds of hematite ore are found near the Pilot Knob, which taken with the ore of that mountain produce the best quality of pig iron.

The ore of the Iron Mountain produces tougher iron than that of the Pilot Knob, while the ore of the Pilot Knob, as is contended by some persons. produces finer steel than that of the Iron Mountain, and combinations of the two produce every desirable variety, and each of the most excellent quality.

The Iron Mountain is near the centre of a tract of 20,000 acres, belonging to the American Iron Mountain Co.

The Pilot Knob, and the various other mineral spurs mentioned above, and lands amounting altogether to more than 20,000 acres, belong to the Madison Iron and Mining Company.

These companies are now engaged in developing a small portion of their inexhaustible resources. Three blast furnaces are now in operation at the Iron Mountain, two of which are just in blast. When all three get in full operation, it is estimated that they will make at least thirty tons per day. One of these furnaces now in full operation made 421 tons of pig iron, and five tons of casting, being 426 tons during the month of April, and in the next month, May, 1855, made 443 tons, being more than fourteen tons per day. This furnace, whose production is so extraordinary, and is said to be unsurpassed, if it is equalled by any other furnace of its size and class in the world, is thirty-eight and a half feet high, and nine feet high across the bosh. The tons are calculated at 2.268 pounds each. The coal consumed in making one ton of iron is 164 bushels, 2,500 inches being the standard bushel of coal, while in Ohio, Pennsylvania and Tennessee, the standard bushel is 2,700 inches. The iron made is mostly No. 2, and is unsurpassed for malleable and car wheel purposes, as also general forge purposes.

The Company have no forge at the Mountain, but Messrs. Prewitt and Patterson are operating one, called Valley Forge, which is situated twenty-five miles from Ste. Genevieve, on the plank road leading to the mountain. This forge commenced operation in June, 1853, and has ten fires. Eight of the Catalan fires are making iron direct from the ore at the rate of from thirty to thirty-five tons of blooms per week. The other two fires, working from the pig made from the Iron Mountain ore, producing what is called the refined of Knobbled Bloom, turn out, together with the eight Catalan fires, about forty tons per week.

Thus it appears that the three furnaces at the mountain, and the Valley Forge near Farmington, together, when in full operation, are capable of producing two hundred and fifty tons per week.

The Madison Iron and Mining Co. have two blast furnaces for making pig metal, and one forge with eight fires—six Catalan fires making iron direct from the ore, and two fires making knobbled bloom at Pilot Knob. One of the furnaces is now being enlarged—built higher—the other is now making twelve tons of iron per day, and is constantly increasing in its daily production. This furnace is 43 feet high, and twelve feet wide across the bosh. It was lately built, and working on hot blast, its capacity is estimated at fifteen tons per day. Furnace No. 1, which is now being enlarged, also 43 feet high and ten feet across the bosh, and which will be completed about the 1st of July, 1855, and also working on hot blast, it is estimated will be capable of turning out an equal amount of iron with furnace No. 2, making thirty tons per day.

The eight fires of the forge are now making about thirty-five tons of blooms per week.

On these estimates and evidences of the capacity of the forge and furnaces at the Knob, which data are derived from different and good authorities, it appears that when in full operation they will be capable of producing 245 tons per week, which, added to the weekly productions of the Valley Forge, and of the furnaces at the Iron Mountain, make a sum of nearly 500 tons per week, and more than 25,000 tons per year.—*West. Journal.*

ON THE PROPERTIES OF IRON,

With the modes of insuring such as may be requisite.—By T. H. Leighton.

Iron is the most useful, and as a general rule, the most generally and largely distributed of all the metals. As an article of commerce it is known in a variety of forms, each possessing peculiar properties differing widely from the others, while chemical analysis exhibits but extremely slight variations in the compositions of the whole. This has been the cause of much perplexity, especially to iron-masters, who have placed reliance on the reports of mere chemists, and many erroneous notions have long prevailed, as sanctioned by high authorities. The constant failure in all attempts to apply chemical science to the manufacture and working of iron, has given cause to practical men to exult at the superiority of practice, and to discard the aid of science altogether. The following concise remarks are submitted as the result of deep study, after protracted and laborious investigations into this most interesting and important subject:

Manufactured iron may be divided into four sections, or species:

Section 1. Pig or Cast Iron.—Iron is in this state brittle and inflexible when cold—fusible at a high heat, and when melted is so fluid that it may be cast into every variety of form; it will not bear hammering, so that it cannot be wrought into any form in the forge. Its analysis is given as iron, with a small per centage of carbon, and a little earthy matter, or impurities.

Remark.—The carbon in pig iron is in a state of cyanogen, and it should, therefore, be represented as iron alloyed with a portion of cyanuret and some earthy matters. This is a fact, although chemists may not be able to detect the presence of cyanogen in their laboratories. The simplest mode of insuring good foundry pig iron is to prolong the operation of smelting, or, in furnace management parlance, to reduce the burden.

Section 2. Malleable, or Bar Iron and Railway Bars.—In this state iron is flexible when cold, infusible by the heat of ordinary furnaces; malleable, so that it can be worked by the hammer into every variety of form when moderately heated. It has generally been supposed that in converting pig into malleable iron, the carbon was merely burned off, and the iron brought to its simple metallic state; but in the operation, a large quantity of cinder is produced, which has generally hitherto been regarded as impurities, or scoriæ, working out of the iron. This has been declared by some eminent chemists to be silicate of iron. Now, instead of cinder being an impurity, it is really a most important alloy of iron, consisting of iron, oxygen and carbon, imparting to

malleable iron all its good working qualities, particularly the property of welding, and its great pliability at a moderate heat. When carbon has been long exposed to a high heat, more particularly in combination with iron, it resembles silicon so nearly in many respects, that an expert chemist might easily mistake the one for the other.

A new mode of converting pig iron into a malleable state is submitted, which is to granulate melted metal, and expose it to the action of steam at a high heat; then to mix it with a due proportion of peroxide of iron and carbonaceous matter. By regulating the qantities of these materials, any requisite property may be imparted to bar iron, to fit it for any particular purpose to which it is intended to be applied. This mixture is to be brought to a welding heat in a furnace similar to a puddling furnace, and balled up; it may then be worked into the requisite form by the existing mechanical operations.

Section 3. Steel Iron, Wire and Tin Plates.—This is, or ought to be, iron in its pure, simple metallic state. It is very pliable when cold, infusible in the heat of ordinary furnaces, and possesses but little malleability. It is at present prepared by a series of expensive and wasteful operations, first forming a large quantity of cinder, and then expelling it by the application of intense heat and great power. It is proposed to form this species of iron in a similar way to the preceding, or section 2, with the exception of using no peroxide of iron, and only a small portion of carbon, mixed with the granulated metal, air being thrown into the working bed of the furnace to assist the welding.

Section 4. Steel.—This is the most valuable form of iron, or, at all events, it realizes the highest price as an article of commerce. To set aside at once all mystery as to the composition of steel, it is merely a mixture of pure iron and carbon. These two bodies do not unite chemically together by themselves. A series of simple and economical operations has been devised for combining iron with any proportion of carbon by means of oxygen, and then for abstracting the oxygen from this compound by the application of free carbon at a high heat. By regulating the proportions of the materials, any quality of steel may be produced, suitable to all the purposes for which it may be required, from a coach spring to a lancet—an intimate and uniform admixture of carbon with iron, and carbon being in the most minute state of division, and near approximation to diamond, constitutes the excellence of steel.

Brief summary—Section 1. Iron combined with carbon by means of nitrogen.—Section 2. Iron combined with carbon by means of oxygen.—Section 3. Iron in its simple metallic state.—Section 4. Iron amalgamated with diamond dust.

THE IRON TRADE.

Among all, to no one is the remark more applicable than to the manufacture of iron. Its horoscope is dark. Its birth in our country was under a faithless star. Yet we dare nullify the astrology of old, and hope for a brighter future. If the past of iron has been uncertain and wayward, we may yet trace its course, and show the mountains that have ruined and impeded its flowing. The earlier manufacture of iron from the ores, certainly suffered much from a want of knowledge on the part of iron masters, while among them have been men of observation and intelligence. Yet the masses have been totally unfit to conduct the delicate and intricate chemical operations necessary to secure the best results. A want of scientific and general business education has caused the failure of hundreds. A greater cause of trouble has been, and is, a want of sufficient capital. In prosperous times, when, in the eyes of the world, furnaces appear to cast dollars, many rush into the business without any adequate conception of the capital required, and with the first change in prices are swept away. The smallest investment that can be made to carry on even a charcoal furnace, is large in comparison with other beginnings in other branches of manufacture. The creeper in iron scarcely ever walks.

Much of the necessity of large capital depends upon the third impediment, viz.: the ever-varying tariff policy. At one time is a tariff which enables the man of small means to commence and invest all in his preparations; and when ready to work profitably, another tariff has been passed, which brings him into direct competition with the capital of Europe, and thus his last dollar is gone. The foreign capital can afford to work without return for a time, so that all rivalry being crushed it can reap far larger returns. Such has been the history of thousands, and such has always been the policy of English capitalists. The rivalry has been unfair—the Government generally siding with the foreign producer. American iron masters' prices have been fixed by the prices of the surplus of Europe, and not by a fair home price.

A fourth point may be found in the fact that since the introduction of coke furnaces, the case has stood "charcoal iron *vs.* coke iron." Coke iron is made at much less expense than charcoal iron, requiring less investment per ton of pig iron made. For many purposes it answers as well. To the public one piece of iron is like every other. The price is the point; and, as a result, charcoal iron must come down to coke iron, or not be made. To sell at the same price was ruin, and thousands were ruined.

The labor of Europe has for years been at the mercy of the capitalists. An existence has been vouchsafed the poor creatures, with only one favorable aspect—its shortness.

In the United States, where is, or might be, at all times, full employment for labor, its prices have been generally remunerating, opening in every one a prospect of health, competence, and happiness. How, then, could iron be made, with such labor, to compete against the labor of Europe?

The cost of transportation from our ironr egions to the seaboard has equalled the cost of carriage from England to our Atlantic cities, the mines of England being almost on her coast.

Such is a condensed statement of the past history of the manufacture of pig iron in the United States. How, therefore, can we look for success where skill, capital, the policy of the Government, the character of the iron, the labor and cost of transportation have been against us? Let us rather wonder that even a few of the many pioneers in this great interest have succeeded in their enterprise.

Our next will refer to the present condition of the iron trade in this country.—*Phil. Com. List.*

IRON FURNACES.

When iron is smelted in one of the huge blast furnaces of South Wales, four tons weight of gaseous products are sent off into the air for every ton of iron smelted, and these gases carry with them an immense amount of heat. Cannot they be robbed of some of this heat, and the heat be applied to useful purposes? Such is the question now at issue; and Mr. Budd, of the Ystalyfera Iron Works, answers it in the affirmative. He does not allow the heated gases and smoke to escape immediately at the top of the furnace; but he imprisons them in a series of flues, where they are made to heat the air for the hot blast, and to produce the steam which is to impel this hot blast into the furnace, and when these services are rendered, he finally liberates the partially cooled gases.

At Dundyvan Works, in Scotland, owing to the enormous quantity of gases which the Scotch coal gives off, we are told that the waste heat from one furnace is actually sufficient to heat the blast, and to raise the steam for three. Mr. Budd even thinks that the waste heat of one Scotch furnace is sufficient not only to heat and supply the blast for that furnace, but to convert the pig iron into bar iron in other furnaces: and he seems to entertain no doubt that the ingenuity of the Scotch will point out the way to realize these advantages. He states that even now, upwards of a ton of coals is saved in smelting a ton of iron in Dundyvan, by making the heat of the furnace do

more work before being permitted to take its aerial flight; but this is so enormous an amount that it seems to require verification. Mr. Budd may yet, however, live to see his prediction verified, that "furnace heat will be let out like mill power, for burning bricks and other similar purposes."

MISCELLANIES.

MINERAL WEALTH OF SPARTANBURG.

We alluded some days since to specimens of lead ore from the lands of Col. Leightner, which, upon analysis, proved of extraordinary richness. Since then more abundant specimens from the same locality have been brought down, and among them copper ores, carbonates and sulphates, which, by the analysis of Prof. Hume, contain not less than one-third the gross weight of pure copper.

In order to show the mineralogical character and promise of this mine, we quote the following passage from the report of Prof. Manrose, who, while engaged in a scientific survey of mines in North Carolina, made an incidental examination of this mine.

The Morgan Mine is situated in Spartanburg District, eighteen miles E. N. E. of the Court House. It communicates by good roads with the navigable waters of Broad River—distance 12 miles. The tract embraces five hundred and five acres of moderately hilly land, well watered and timbered, and in a good state of cultivation.

The course of the vein is N. 85 E. with a dip to S. E. of about 70 degrees. The enclosing rock is a micaceous slate, having the same strike and dip as the vein. The walls are well defined, striated, glazed, and polished.

The mineral contents of the vein are:—

1st. Galena or sulphate of lead, in masses of from one to fifty pounds.

2d. Phosphate of lead, coating cavities and forming small veins.

3d. Carbonate of Lead, in crystals and veins, often constituting a rich ore.

4th. Stones of copper pyrites, of twenty to thirty pounds weight, with small quantities of green carbonate of copper.

Of these ores the galena is far the most abundant; the other ores of lead may be expected to disappear at no great depth, while the copper will increase in quantity. The galena is highly argentiferous; twenty-four pounds of the undressed ore yielded in the crucible fourteen pounds of fine lead, and four of this metal afforded three pennyweights, nine grains of silver, equal to eighty-four ounces of silver, for two thousand pounds of metal; or forty-nine ounces for two thousand pounds of undressed ore. Such an unusual richness in silver renders this lead ore peculiarly valuable, and its value is fortunately not diminished by the presence of zinc, arsenic, antimony, or any of those substances which often render ores almost worthless. The richness of these ores, their freedom from impurities, and abundance in the vein, leave no other question unsettled regarding the prospective value of this mine, than the extent of a workable vein.

The vein has as yet been penetrated downwards only about eighteen feet; thus far it retains its full width, and its walls become constantly firmer and better defined. From this fact its persistence to greater depth may be fairly inferred. The only change which can be perceived in the metallic contents of the vein in descending is the greater abundance of copper ore. This mineral promises to add still further to the value of the vein when a depth shall be reached at which the copper has not been removed by decomposition.

In regard to the linear extent of the vein, the following facts will speak for themselves:—To the south-west the land is low and marshy, and affords no opportunity of tracing the vein in that direction. But to the N. E. following the course of the vein N. 85 E. it may be traced at intervals by its

outcrop of ferruginous quartz, over a distance of one hundred and two rods. Here at No. 2, a pit has been sunk a few feet which reveals a vein identical in width, dip, direction, and mineral contents with the vein at No. 1. The conclusion is unavoidable that these two points are upon the same vein, and of course that it is continuous over the intervening distance. With these facts in view, I do not hesitate to pronounce this place one of great promise. Whether the argentiferous galena shall continue to be the prevailing ore, or, as is not unlikely, shall give place to copper, in descending, matters little to its ultimate value. In either case the abundance of valuable mineral within the present trifling distance from the surface, gives ample promise of rich retruns below.—*Charleston Mercury.*

DEPOSITING OF ALUMINUM AND SILICUM.

Mr. Gore, of Birmingham, has succeeded in depositing aluminum and silicum upon copper, by the electrotype process. To obtain the former, he boils an excess of dry hydrous alumina in hydrochloric acid for one hour, then, pouring off the clear liquid, adds one sixth its volume of water. In this mixture was set an earthen porous vessel, containing sulphuric acid, diluted with 12 parts of water, and with a piece of amalgamated zinc plate in it. In the chloride of aluminum solution, was immersed a plate of copper, of the same amount of immersed metallic surface as that of the zinc, and connected with the zinc by a copper wire. The whole was then set aside for some hours, and, when examined, the copper was found coated with a lead-colored deposit of aluminum, which, when burnished, possessed the same degree of whiteness as platinum, and did not readily tarnish either by immersion in cold water, or by the action of the atmosphere, but was acted on by sulphuric and nitric acids, whether concentrated or dilute. If the apparatus is kept quite warm, and a copper plate much smaller than the zinc plate is employed, the deposit appears in a very short time—sometimes in half a minute; if the chloride solution is not diluted with water, the deposit is equally, if not more rapid.

The author has also succeeded in obtaining a quick deposit of aluminum, in a less pure state, by dissolving common pipe-clay in boiling hydrochloric acid, and using the clear liquor undiluted in place of the above-mentioned chloride. Similar deposits were obtained from a strong aqueous solution of acetate of alumina, and from common alum, but more slowly. With each of the solutions named, the deposit was hastened by putting from one to three small Smee's batteries in the circuit.

To obtain the deposit of silicum, monosilicate of potash (prepared by melting together 1 part silica with 2 1-4 parts carbonate of potash), was dissolved in water, in the proportion of 40 grains to one ounce measure, proceeding as with aluminum, the process being hastened by interposing a Smee's battery in the circuit. With a very slow and feeble action of the battery, the color of the deposited metal closely resembled that of silver.—*London Artisan.*

A MINE OF BISMUTH.

A correspondent—J. J. Herschbuhl, Louisville, Ky.—informs us that J. G. Balee, of Simpsonville, Shelby Co., in that State, has discovered a deposit of bismuth, largely mixed with the soil, on his plantation. The metal was taken from the ground, melted in an iron ladle, and sent in a bar to Louisville, to be analyzed by Charles Mohr, chemist. His statement is, "the metal is very brittle and fusible, and exhibits by the blowpipe the characteristics of bismuth. It readily dissolves in concentrated nitric acid to a clear solution. Muriatic acid acts but feebly upon it. The solution in nitric acid was subjected to the regular course of qualitative analysis, and the result obtained was nearly pure bismuth. There were some traces of zinc and iron, but the quantity was so minute as to be regarded unimportant in the practical applications of this metal. The discovery of bismuth in Kentucky is a new feature, we believe, in the mineral resources of that State.—*Scientific Amer.*

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WILLIAM J. TENNEY.

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VOL. V.—AUGUST, 1855.—No. II.

Art. I.—LEGITIMATE MINING—ITS CHARACTER.—No. 2.

In an article which recently appeared in these pages* relative to the initiatory steps often taken to organize mining enterprises, particular attention was bestowed on that class of operations, purely of a scheming and speculative character. Systematic, scientific, legitimate mining enterprises were only alluded to without entering into detail respecting their proceedings. This point it is proposed now to illustrate:—"A large mine is a very complicated machine. To understand it thoroughly, involves a study of boring, sinking, pumping, winding, hauling, getting and ventilation. It requires the aid of mineralogy, geology, mechanics, pneumatics, chemistry, &c."

The examples of legitimate mining are quite numerous in this country—although it is recently that public attention has been turned in earnest to this great branch of industry. The region around Lake Superior can furnish examples, so likewise Virginia and North Carolina; while for collieries, Pennsylvania takes the lead. A statement in detail of the business of a mining company at any particular period, is a subject of more importance to parties interested than to the public generally. Where those operations are on an extended scale, and involving a large outlay of capital, and demand talent and science to conduct them, the example becomes interesting, by the instruction it affords. At the same time, the contrast presented to the manner in which "illegitimate" mining enterprises are pursued, is too apparent to escape the observation of the most inexperienced. We propose to illustrate this point, at this time, by some extracts from the proceedings of the Vallecillo Silver Mining Company, whose mine is located in the Republic of Mexico, but the proprietors are citizens of this country. We notice their operations at this time, not because they furnish a better illustration than many other Mining Companies of our country can show, but because they are at that stage of their enterprise where the courage of so many fails, and which

* Mining in Wall Street. Vol. IV., page 370. June, 1855.

requires the proprietors to fall back on the reserved capital, relying for remuneration upon the accuracy and skill of the science and experience which has advised and guided them; and also, because we have a more full detail of their proceedings during the recent period of financial embarrassment. There are many other companies, whose operations will furnish, on another occasion, illustrations of sound and legitimate mining.

The Vallecillo Silver Mine is located in New Leon, in Mexico, at some distance from the Rio Grande River. On page 684, vol. II. of this Magazine, will be found the particulars of its location, and a map of the shafts and galleries. The report made to the proprietors aims to present a statement of what has been recently done, what remains to be accomplished, and how it should be done. It is from the pen of Mr. J. N. Reynolds, and is introduced with the following remarks:

It is not necessary to remark, that the past year has been one of unusual disaster. The best of enterprises have failed. The wisest calculations have been disappointed. In too many instances the honest hard earnings of years have melted away. It has been a year of unavoidable forced contraction; a long gloomy distrust pervaded the whole business of the country, and yet this enterprise has moved on; if not so rapidly as it might, still without stoppage, and it is now drawing near completion free from all encumbrances worth speaking of. When the organization of the company was perfected, the new machinery ordered, and the enlarged plan of operations agreed on, an ample fund of reserved stock was set aside, as the source to lean on. This was understood by all—this fund is still ample, more than sufficient for any demands that may be made upon it.

There have been delays, unavoidable because they could neither be foreseen nor provided for. These have been vexatious, exceedingly so, but not disastrous.

There has been six months' delay after time contract for the completion of the machinery. It was conveyed from Norristown to Philadelphia in part by wagons made expressly to be sent with it, and from thence freighted to the banks of the Rio Grande without accident.

As chairman of the Executive Committee, the correspondence and direction of the whole work has mainly devolved on me, and I cannot present, perhaps, in better form the progress of the labors than by a condensed review of what this correspondence has been.

In August I wrote to Dr. Prevost, and placed to his credit in Monterey for the use of the mine, the sum of sixteen thousand dollars. The machinery had already been despatched. I recommended him to get permission from the Mexican Government to pass the machinery at a high point up the Rio Grande. On mining materials there is no duty. I desired him to take the engineer in chief and part of the machinists sent out, proceed to the mine, and commence work, as there was a long and heavy job to be done before the machinery would be needed, allowing ample time to get permission and effect the transportation to the mine. My instructions might be condensed into few words: have the work done well in all respects, and as quick as possible, without on my part attempting to name a day, week, or even month, for its completion.

Dr. Prevost, who came down from the mine to meet the machinery in Brownsville, wrote me on the 28th of July. He expressed his high satisfaction at the power and completeness of the machinery and abundant supply of mining materials, with the full conviction of what results may be expected from their application to the purposes intended. At the mine all had gone on well. The new shaft had been sunk for the reception of the new machinery. The deep underground work and the extraction of ores had of course been suspended. The seventy men, chosen miners, we had brought from Zacatecas, were mostly in the neighborhood, and waiting patiently to begin work again. The works in the "*Hacienda*," or reduction establishment, had not been suspended, and the whole expense of that department had been more than realized from working over the old "*residios*" remains which had in fact been thrown away. This was most satisfactory, not so much on account of the amount of silver extracted, but because it kept up this important organization, and gave assurance of the future, that may be better left to tell its own story. The mine was out of debt, not a dollar was owing to any one, and it was that and other circumstances which combined to secure to the enterprise the entire confidence of the State and people of the district. He stated, also, that application, backed by a strong letter of recommendation from the Collector of Customs at Matamoros, had been sent to the city of Mexico, for special permission to pass the machinery up the river!

The next letter from Dr. Prevost was dated at the mine, in August, to which place he had returned with the engineers and commenced work. He went by Monterey, and received a very strong letter from General Ampudia, the military Governor, to Santa Anna, in favor of the application. In this letter the doctor urges strongly the importance of carrying on the works at the *Dolores Mine*, as the additional expense would be small, the engines and pumps on hand, with some slight alterations, being quite sufficient. Indeed, he had already commenced work on this property, and had repaired one third, or seventy feet of the shaft, which is only 210 feet deep where it cuts the vein full of ore. He repeats what tradition and existing records prove, that this Dolores Mine had yielded immensely, giving at one time employment to no less than *four hundred* Galemes, small smelting furnaces peculiar to the country; that the *Hacienda* or reduction works prepared at the other mine, would answer for the ores of both mines,—the same staff for both; the same workshop, besides many other advantages that need not be dwelt on here!

His next letter is also dated at the mine, September 3d. The deep foundation for the works had been dug and blasted out, ready to commence the building and shaft work, and they felt confident of being able to produce a fine job. The recent disturbances on the frontier had not molested them in the least. There is, in fact, no instance of mining operations in the country having been disturbed by these irregular modes the Mexicans have of deciding their elections. The workmen at the mines are exempt from military duty, and cannot be made soldiers of. The brickyard, stone quarry, and lime kiln, were in full operation. Considerable improvement had been made by Mr. West, the head engineer, in our small engine intended for the Dolores Mine.—Mr. West is the father of the machinist who constructed our new engine and accompaniments. This is the fifty-sixth engine of this class, the erection of which he has superintended in England, Ireland and

Wales. He was sent for to Cornwall in England for the express purpose of superintending the erection of this. The contract of the builders is not complete till the water is out of the mine; and all the master workmen are all this time under pay of the contractors, and not of the company. It is their interest as well as ours, that the work should be completed as early as possible; but it is for the interest of neither, that any ill-judged impatience should have it prematurely or badly done. The work now drawing near completion will last for generations. The doctor again urges the importance of bringing into operation the Dolores Mine. No answer from government as to passing the machinery, and apprehensions are entertained lest the letters have miscarried amidst the disturbances of the interior.

The next letter is dated at the mine, October 28th. I quote his words: "Every thing goes on here as well as could be expected. The work on the new building and shaft is a slow and heavy job, but could not be a more solid one if done in Cornwall itself. We progress, I think, fully as fast as such works can be done in this country, and in fact as fast as such works should be put up at all." The only vexation was in getting permission from the government for passing the materials up the river at *Mier*, though this delay had not as yet been prejudicial. He had sent his assistant, Mr. Burgess, down to Matamoros with a sufficient number of oxen to draw up the wagons with the heavy pieces of machinery, in order to prove in this way to the exorbitant freighters, that if they would not come to reasonable terms, he would himself do the job. He still continues to pay the expenses of the "Hacienda," with the silver which Valdero, the head Mexican in this department, still continues to extract from the very dirt and refuse of the mine. This is a most gratifying circumstance, as it proves the perfection to which this delicate process of extracting silver has been brought in our own establishment, as well as indicative of what may be done from the pure ores of the mine, after the work is again renewed.

This Valdero is one of the most skilful of his class that could be found in the interior, and he has remained at the mine during all this time, on wages which barely afford him support, from his entire conviction of the rewards that await him in future. The Mexican miners, a distinct class of themselves in the country, are proverbially very sagacious in these matters —they run from a bad mine as sailors desert a sinking ship: they are now coming in squads from various parts, even as far as Zacatecas, to our mine, in anticipation of the erection of the machinery and the renewal of the work.

It is now known, that the delay in getting permission to pass the machinery was owing to the non-arrival of the application from Matamoros at head-quarters. At an early period the Mexican minister, Gen. Almonte, had written at my instance, direct to Santa Anna, to grant the facility asked for from the Rio Grande. To this the President replied, that no application had reached him, though friendly letters had reached him on the subject. The return mail from the United States to Mexico took an application direct to Santa Anna in behalf of the Company, which General Almonte enclosed. This reached its destination, and my next letter from Dr. Prevost, dated in December, informed me that the application had been granted, and that the movements would now take place, in all probability as soon and as fast as the materials would be needed, their non-arrival having not even yet deranged operations I do not know how much,

if any, delay all this will occasion. It is an obstacle to be overcome, not dwelt upon. When all things are ready the mere placing the machinery and shaft work in place is comparatively a brief job. The heavy task was the work preliminary. It takes time and it takes money, and this is the reason why it is worth while for men to be engaged in it.

Of all the heavy machinery sent out, the most complete and perfect in construction (duplicated where duplicates can possibly be needed) that was ever made in the United States or sent into Mexico, with a most abundant supply of mining materials, tools, implements of iron and wood, and a large stock of assorted cordage, steel and iron, weighing in all three hundred thirty-nine thousand four hundred and forty-three pounds, (339,443), not a bill remaining unpaid, but four thousand dollars not due on the contract till the water is out of the mine and the work received from the contractors' hands as complete. The freight has been paid for. No debts remain at the mine. The credit for sixteen thousand dollars sent forward has been provided for; fifteen thousand dollars of additional credit to be supplied in Monterey, at the rate of three thousand dollars per month, has been ordered—and only a small portion of this remains to be provided for, not by assessments, but from the still ample fund of reserved stock, set apart for this or whatever in addition may be regarded as necessary and proper.

It is but proper to state, that in less disastrous times than the past year, more perhaps might have been accomplished by bolder operations. The magnitude of the work, the labor performed, and obstacles overcome in the construction of such machinery, and its transportation from Norristown, Pa., to Vallecillo, Mexico, with the heavy works at the mine, preparatory to its reception and being placed in position, and all performed without accident, is, or should be satisfactory. The completion of this heavy job is now drawing near. I do not pretend to set the day precisely, but this I do now take upon myself to declare, with as much certainty as good soil, by good culture will produce wheat—that before the close of the present year, a weekly product of silver bars may be issuing from the "Jesus Maria Mine," soon to be followed by like fruits from the Dolores Mine, and that it will be the fault of the company if the joint yield of both mines, in a short time, shall not be from three hundred thousand to half a million of dollars, annually—and there will be years or periods of still greater yield!

It is admitted such estimates are generally of little worth. To those unacquainted with a well developed and equipped mining concern it may appear too large. It would not be so regarded in Mexico; but with such an estimate there, as it should be every where, is coupled a systematic, efficient, and bold plan of carrying on the works.

The remarks which immediately follow are worthy of reflection by the true friends of mining enterprise:

In this work no short roads have been attempted. No flaming reports have been made or published—no letters written to order; step by step the means have been applied to overcome all difficulties and produce the ends desired. One matter should be borne in mind: the stock of this Company has never been thrown on the public. No favor has been asked of the pub-

lic. With its merits or demerits the public is wholly unacquainted. There has been no speculation in the stock—there has never been a transfer-book opened. No original party has had his stock issued, except as he increased his interest from the reserved fund and paid for it the same as any other party. In sales made it has been intended, and is intended, to place new parties on a footing of equality of those of older date, by paying a small advance over what those have paid who have been long and patiently at work, and who took all the risk of opening, and in fact proving the mine. This system is still recommended, as it provides for a gradually rising scale, and produces a unity of interest and purpose. The stock, if ever, should not be placed on the Board till the silver from the mine has created an inquiry and demand for it.

Every human pursuit in which there is a possibility of loss, however enormous may be the gain, is more or less speculative in character. Mining enterprises are not free from this law, especially in all expenditures until the regularity and fruitfulness of the vein be thoroughly proven, at sufficient depth. Whether or not the point has been attained or even past, in which it would be weakness to treat this enterprise as any longer speculative, we have no asseverations to make,—each one must judge for himself. With the heavy machinery on the most efficient scale, complete for one mine, and nearly so for the second; with the very best practical men to fill the posts of responsibility to be found in Mexico or this country, who have staked their reputations and deem it no hazard to place their hopes of reward on the future products of the mine, it only remains that we should finish up at this end, and do it like men who are handling an important enterprise and not a bubble.

It is not, however, a charitable institution, and no one is expected or desired to take an interest in it, if he thinks he can do better with his money; but it is necessary that there should be from this time more activity, simply because the delays which have been unavoidable, indeed necessary, are now in a great measure overcome.

The disposition of the reserved stock to proper persons, who will not need the proceeds to pay a sixty days' note, and who are willing to wait a reasonable time, and to rely on the proceeds of the mines, and not from the premature sale of stocks, can only be done properly by an intelligent co-operation of all interested; because each person who took or takes an interest at fair and not speculative rates, is as much bound to do his part as any other party, including the writer, who is himself only a stockholder in common with all,—and the great advantage of this concert is, that the circle becomes gradually enlarged and strengthened, while no discordant materials are brought into the concern. From this time forward it is easily managed. The heavy, annoying, and perplexing labors are mainly over. An honest, capable, and faithful agent as it now has in Dr. Prevost and assistants, and two others, ready at the proper time to go out, the one Capt. W. W. Palmer, Mining Engineer, and Prof. Louis Posselt, Assayer and Chief of the Hacienda, or silver department,—it would be difficult to have the matter go wrong. Good faith admits that I should have more relaxation at an early day. I have a right, therefore, to ask and expect a lively co-operation, not only from the Board, but others holding an interest, in the little that remains to be done at this end. It is a light matter for concerted action. * * * *

The following extracts from the correspondence will show a wonderful interest felt among all parties engaged in this enterprise, which is sure to triumph over all difficulties:

The next letter received from Dr. Prevost, after the above had been drawn up in manuscript for the use of shareholders, was dated Brownsville, January 23d. Annoyed at the delays in getting permission to pass the machinery, and still more at the exorbitant demands of the steamboat men of the Rio Grande, in violation of previous agreement, after permission had been granted, and the forward state of the works at the mine not admitting of further delay, the Doctor came promptly to the proper conclusion, and passed every piece of the engine, machinery and mining supplies, over the Rio Grande, at Matamoros. This passage of the river was alike bold and successful. Hogsheads were lashed round the ferry boats to give them the requisite buoyancy for the heavy pieces: not an accident occurred—and without loss of time, the strong wagons sent out, were laden with the heaviest pieces, and on the way to the mine.

The next letter was dated at the mine, January 31st, enclosing an account current of the expenditures at the mine for the past year. The works carried on had not been heavy, being exclusive of the machinery, $23,866 03, leaving a balance in the treasury on the 1st day of January, 1855, of $8,081 13. The Doctor says: "The works here are rapidly drawing to a close. The Cornish men and day laborers have all worked with a good will, and are becoming more animated each day, as they draw nearer to the expected treasure. The faith of the operatives in the mine has been well tested, for they have all worked on considerably reduced wages, without any other hope of reward except such as are conditioned alone on the success of the enterprise." This is the confidence of practical men whose lives have been past in such employment. The Mining District, he writes, had considerably improved during the past year. Catorze was yielding richly, the mines at Zacatecas were paying well. The mine of Fresnillo produces weekly $28,000, and this amount was likely soon to be doubled. Quebredilla, which began to yield only a few months ago, after needing an outlay of $200,000, has declared its first dividend reparting among the stockholders over $80,000. "Such," says the Doctor, "are the signs of the times, and that it depends upon us whether or not our harvest shall be as good or better!" The delay of the machinery at Matamoros had been vexatious, though unavoidable; but this was of little real importance, as it was not needed till now. After transporting the heaviest pieces to the mine without accident, the Doctor returned to Matamoros, and wrote me briefly from that place, under date of April 20th: "Consider another heavy portion of the machinery at the mine by the time you receive this, and the building complete. No accident occurring, the engine will be at work by the 1st September or during all of that month at furthest." "I am determined," he continues, "to go through with this, and to show the doubters of the success of the Company (if any) that nothing can prevent us from obtaining the prize now almost within our reach. It is as much a matter of character and honor with me as with you to carry this enterprise forward until the machinery is in motion, the mine drained, the Hacienda thoroughly organized and the results placed beyond doubt."

The next letter received bears date at the mine, May 25th. It cannot be well condensed, and is as follows:

Your favor dated New York, February 27th, came to hand last month. I did not at that time write you extensively, as I received the letter referred to while en route for Matamoros, from which place I dropped you a few brief lines, informing you of having favorably contracted for the balance of the freight, which I am now daily expecting here. The present very disturbed state of the frontier may occasion a few days delay, but cannot, I conceive, prejudice our interests in any way. The freighters are apt to hold on for a few days, to let the first storm blow over for fear of having their mules stolen; this is the only delay.

Our building was completed some time since, and the machinists are at work at their proper employment. Mr. West asks till September to start the engine. Although we have sustained no real damage from so many delays, since the arrival of the engine in Brownsville, because the work was necessarily a slow one, yet the patience of the Company has no doubt been severely tested, by the unaccountable enmity and opposition of the steamboat company, whose agents, from the very commencement, have proven to me by their unaccountable conduct, that some secret agency was operating with them against us. It is not easy to divine the exact cause or nature of this opposition. Personal dislike to you, or to the officers immediately intrusted with the management, forms no part of it, as I am convinced from my intercourse with them. I received in December last intimations through friends in Monterey, of reports in Brownsville, respecting the purposed detention there of our machinery, with a view to discourage the company from the enterprise, so that the mine and property might fall into other hands, anxious enough to obtain it now and to enjoy almost without risk the *treasure* which we have labored so much to secure. This was the cause of my action, in risking every thing to cross to this side in January last, and I am exceedingly happy to find by your communications, that you approve of a course so contrary to that I knew you desired to have adopted, and all of the circumstances leading to which it was not easy for me to explain. You are aware only of the violation of contract by the steamboat men, respecting the price of freight as stipulated between you and them. You do not know, for I have avoided you the additional disgust, all the petty annoyances and repeated breaches of engagements, to which we submitted with the hope of eventually getting up the Rio Grande. No matter what the motives may have been, we are now beyond harm or further annoyance. During all these vexatious delays, I cannot too highly commend the conduct of the native workmen, who, in despite of reduced wages here, and the immense temptations by higher wages, held out by the brilliant *Bonanzas* now enjoyed by Catorce, have held fast to their first faith, and build all their hopes of fortune on Jesus Maria and Dolores.

If Mr. West fills his promise to start the engine in September, four months will be ample time to perfect the communications below with all the *labors* or drifts left in fruits, and I hope that the sight of our first fruits in New York will reward the constant exertion and unwavering faith of so long a time—there are no *short times* in the first operations of a large mine. The dame fortune who presides over mining affairs is hard to woo, but once won rewards with no niggard favors, but with all the

charms of immense and suddenly acquired wealth. We have waited long and patiently, and I think worked well; we cannot believe that with such fair appearances, and the smile that just now begins to beam, she will ever deceive us. Under any circumstances it is, or should be, satisfactory to reflect, that the Company's money is securely invested, as the mine property now here is worth far more than its original cost.

From Catorce they have written for information respecting our engine, and are desirous of having one made like it. This information was sought through the house of Oliver. Our train of wagons being no longer required, I have written to offer them for sale and I have no doubt of securing favorable terms. On the arrival of the iron, the *Lavedero*, long since completed, will be set up and every thing got in readiness for rapidly reducing the ores as fast as they come out. I have often before mentioned the perfection to which our "*beneficiation*" extraction of silver has been brought, and this will be seen better when we come to work on a large scale. The new *Malacate* hoisting apparatus, erected with stone pillars, is to-day finished. That put up by me, in *Dolores*, is also of stone. The number of animals belonging to the Hacienda (mine) including those of the teams, is over fifty mules and six or eight horses. The stock of powder, candles, ropes, hides, sulphate of copper, mining implements, and materials, &c., &c., is sufficient for a long time to come. We enjoy the confidence of all parties, and the co-operation of Government whenever we have any need of it. In fact, our present state and prospects are all that can be reasonably desired.

When shall we expect a visit from you and Mr. Palmer, accompanied, if possible, by others of the stockholders, to cap the climax of our satisfaction? I must remind you that the last instalment on the credit of $15,000 opened with the house of Shiers & Oliver, will be paid in July, and I need not urge the necessity of continuing these instalments without interruption for some time to come.

From the reply to this letter, we take only the following passages:

By the time you receive this, the period will be close at hand when you will begin to place workmen in the mine, in places first laid bare, for the extraction of ore. You will exercise your own judgment—how far it may be proper as well as wise in policy to make contracts with Bareteros and others, for a certain percentage of the ores they may take out, within certain limits, and with the accustomed restrictions as to time, &c. In a word, you know how to inspire the head-workmen in all the departments with a common feeling in our success; besides, they have behaved so well, held on with such abiding faith, that I shall feel gratified in seeing the meritorious well rewarded, and in this feeling I know full well my associates will concur. With the stockholders in this company, no extravagant expectations are entertained. They look to the mine, and not to speculation in the stock for the returns of capital invested. The expression, therefore, in one of your letters—that the success of the enterprise was as much a matter of honor with you as it could be with me, was gratefully received and duly appreciated. True, I am but a stockholder in common with others; yet, somehow or other, more seems to be thrown upon me. When both mines, under one compact organization, are in fruit—with all their

varied operations above and below ground—it will indeed be worth a visit to see you; and you will then have visitors—nor will it be many years after that when the returns from that mineral district will be felt and acknowledged even in this great commercial emporium.

Whenever you commence work in the Hacienda, however small the beginning, in reducing ores taken from the mine, you will transmit, on the 1st day of each month, the whole business proceedings of the past month, in regular form of weekly and monthly *memorias*, in English, to this city. For this purpose, you will despatch some trusty employee with the communication to the nearest post-office in Texas, say Roma or Rio Grande City.

The entire document closes as follows:

The subjoined statement of Prof. Posselt, on the Dolores Mine, will suggest some of the reasons showing the propriety of working it; and the bill of lading will give a better notion than can be otherwise entertained of the kind of labor it has been to transport and place in position such a quantity of massive materials.

These different reports, now brought into one for the satisfaction of the stockholders, might have been, and perhaps should have been more briefly made, but could not in that case have conveyed so good an idea of how the work has been carried on. It is not intended for the public; and if any thing further is wanting in business detail, all the parties in interest who have a right to be informed, know how and where to supply the deficiency. There is still, however, much to do before the two mines are thoroughly equipped and brought into regular working condition, but it is so light in comparison with what has been done, as to be scarcely worth mentioning. To do this, the reserved fund is still ample, and to this object it should be promptly and faithfully applied. There is no danger of doing too much work on a mine, provided the vein be good and the work well directed. The great *beginning* works of the enterprise completed, as they will be at an early day, there will be, I trust, no disappointment in store, for the work has been thorough in all respects, and reputation is always safe, when men have legitimately applied the means with the requisite skill, labor, and patience to command success!

MINA DE DOLORES, VALLECILLO.

Near the town of Vallecillo exist large surface excavations, originally made on the outcrops of the vein. They yielded immense quantities of argentiferous lead ore. The Spaniards sank a number of shafts on this vein—two to the depth of about three hundred feet. At the close of the last century, and at the beginning of this, these works were in full operation. It is of authentic record, that they supplied 400 smelting furnaces (Galemes), situated at the neighboring river of Sabinas, with ore, yielding about 6 oz. of silver to the 100 lb. The political disturbances, beginning in the year 1810, checked materially the progress of this flourishing mining district. However, notwithstanding the civil war, a company of Spaniards, whose head-quarters were at Monterey, continued the works and sank a new shaft, which cut the vein at 210 feet in good ore—they took out pieces of pure argentiferous galena, weighing 500 pounds; and were occupied in establishing a better ventilation in the mine, when the decree

of expulsion appeared, and forced them suddenly to leave the country, depriving them of the fruits of their successful labor. The war and the subsequent incursions of the Comanches, depopulated and impoverished the country to such a degree that the works could never be taken up again till now, when the present company is putting up the engine used at the "Jesus Maria" mine, with many improvements, on the shaft sank by the old Spaniards, and called by them "Mina de Dolores."

The force of the old engine, as now being improved, is more than sufficient to raise the water and keep the mine dry, because it is situated higher than the mine of *Jesus Maria*, and contains much less water. An immediate extraction of silver-bearing lead ore, can take place, which will be of the highest importance to the interests of the company, not alone on the account of its richness in silver, but also as a valuable help for the reduction of silver out of some kinds of ore of the Jesus Maria Mine.

The richer classes of the black ore of the latter mine, and its argentiferous copper ores, are reduced with a much greater advantage by smelting, than by the Patio or even the Cazo process. Wood and charcoal can be procured in abundance from the surrounding extensive *musquite* forest, and thus an immediate and rapid production of silver is established, sufficient to pay the expenses of the company from the beginning. It is probable that the lead ore, by going down, will gradually disappear and be replaced by silver ore, a circumstance that took place at the mine of Jesus Maria.

The mine of Dolores being connected with Jesus Maria Mine by a good carriage road, only one league distant, and on the same vein, can be worked without materially increasing the expenses of the company. Its ores will be taken to the reducing establishment of Jesus Maria, and the same staff of officers, workshops, &c., will be sufficient to carry on both works.

It is, therefore, my opinion that this mine ought to be worked at the same time as Jesus Maria, in such a way, however, that the works at the latter mine would not be retarded by it.

DR. L. POSSELT.

In conclusion, the reader's attention is referred to the list of supplies shipped to this mine, which is to be found under the head of "Journal of Silver Mining," in a subsequent page of this number of the Magazine.

ART. II.—GEOLOGY OF WISCONSIN. BY JAMES G. PERCIVAL. No. 2.*

SURFACE DEPOSITS.

THE rocks, in the mineral district, are overlaid by a deposit of earthy materials of greater or less thickness, in some places to a depth of more than thirty feet. This consists generally of a strong

* Continued from page 361, vol. 4.

clayey loam, called surface clay, of a light brown color, forming a subsoil at once free and retentive, and itself fertile. Formed apparently by subsidence from still water, from the decomposition of the upper rocks of the district, in which limestones, alternating more or less with shales, predominated, it has at once the characters of a calcareous and argillaceous soil, mixed with sufficient silicious matter to render it easy of tillage. It is only in very wet seasons that its adhesive quality is found inconvenient. In dry seasons, when other parts of the country, where the soil is lighter or more entirely clayey, have suffered from drought, this district has not been affected by it, and has yielded abundantly. It thus offers the rare combination of agricultural capabilities of the first order, united with mineral resources fully equal. Wherever the limestones form the surface rock, this clayey subsoil prevails. Where the upper sandstone is brought to the surface, there is a greater predominance of silicious matter; but this occurs to a small extent in the mineral district. In the valley of Sugar River, and in the country extending east from that to Rock River, north of the parallel of Janesville, where the upper sandstone is exposed to a larger extent, more sandy soils are frequent, but still fertile, and wherever the blue limestone extends in the swells and ridges, more loamy soils are observable.

Beneath the brown surface clay, there is usually found a layer of red clay, more or less filled with red or yellow flints, immediately overlying the rock, and often found extending to a greater or less depth into the open crevices. It is different from the clays occupying the openings and immediately investing the mineral, and has been apparently formed by subsidence, like the overlying surface clay.

The mineral district does not appear to have been invaded to any extent by the gravel and bowlder drift, which has covered so extensively other parts of the surface in this and the adjoining States. Apparently the bold escarpment, backed by the high ridges and prairies, along the south side of the Wisconsin River from a point not far east of the Blue Mounds, has obstructed the course of the drift current, and turned it east and south around the east point of the ridge at those mounds. An opening near the source of Sugar River seems to have given passage to that current, by which large accumulations of gravel drift have been formed along the west side of the valley of that river, near Exeter, and of bowlder and gravel drift farther east, while scattered bowlders, usually of no great size, are found in the side valleys, and on the slopes of the adjoining ridges and prairies, towards the west, as far south at least as the vicinity of Monroe. In the tract of country occupied by the blue limestone and upper sandstone, between the high prairie, west of Janesville, and the ridge of the lower magnesian, south of Madison, accumulations of such diluvial drift are comparatively small and unfrequent, but with occasional excep-

tions, while on the north of that ridge they are large and extensive; that ridge having also acted apparently as an obstruction to their progress. My observations in that part of the country, covered more or less by this diluvial drift, have been very limited, and a farther consideration of its extent must be deferred to a future occasion. The bowlders and smaller rock fragments, composing this drift, are chiefly derived from primary and trap rocks, though partly from the flints (hornstones and quartz) accompanying the limestones, particularly the lower magnesian. Small nodules of hematite, and of iron pyrites partly converted into hematite, such as occur at the junction of the blue limestone and upper sandstone, are frequently found in this drift and scattered on the adjoining surface.

In the immediate vicinity of the Mississippi, on the surface of the higher ridges and prairies adjacent, accumulations of drift are occasionally found, in some instances quite extensive, composed of a fine sand, usually yellow or light brown, as if formed from the sandstone adjoining that river towards the north. These are generally arranged in hillocks, with intervening round hollows or basins, such as are common in drift districts. This sand, on the surface, is mixed more or less with mould, forming a light soil, but at a small depth is sufficiently pure for mortar. A tract of 2—3 square miles, covered with such drift, and remarkable for its hillocks and hollows, extends from the bluffs of the Mississippi to the valley of the Great Menominee, S. W. of Jamestown village, and similar accumulations are met with on the high lands, adjoining the Mississippi, between Potosi and Cassville. On the summits of the river bluffs, particularly in the vicinity of Cassville, small rolled fragments of the same materials as those composing the gravel drift, above noticed, are often profusely scattered. These facts indicate the passage of a peculiar drift current along the course of the Mississippi, and it is worthy of remark, that the points where those accumulations are most remarkable are a little below two large bends in that river, namely, that from south to south-east just above Cassville, and that to the south between Dubuque and Potosi. Such a deflection would naturally cause an eddy, and thus lead to those accumulations.

MINERAL DEPOSITS.

The first object of the present survey is the investigation of the Lead Mines of the mineral district, and of the different useful minerals connected with them. The previous description of the strata is important, as fixing definite limits in mining, and from their peculiar connections with the mineral deposits.

The metallic ores found in the mineral district are chiefly the sulphurets of lead, zinc, iron and copper. Other ores of these metals are also found, formed apparently by recomposition from

the decomposed sulphurets. Such are the sulphate and carbonate of lead, the carbonate and silicate of zinc, the sulphate and hydrated oxide of iron, and the carbonate of copper. The black oxide of manganese also frequently accompanies the mineral deposits. Of these ores, the sulphuret of lead (galena) is the most important, and that which has been hitherto the sole object of mining in the mineral district, except in one instance (that of the copper, at Mineral Point.) I shall therefore make it the first object of my attention, and notice the others only as far as they have an immediate connection with it. The term *mineral*, in the mining district, is restricted to the ores of lead, and without addition to the sulphuret, and is the term generally used there for the latter. I shall for convenience use it in that sense, in what follows.

The first subject to be considered, is the manner in which the mineral is deposited. It is a matter of great interest to determine, whether the mineral is arranged in continued veins, or in detached and casual deposits. The prospects of mining must be much greater, if the former arrangement prevails, than if the latter. During the whole course of my examination of the mines, I have made this a particular object of attention, and although interruptions in the deposit of the mineral are general, as I believe is the case in all veins, yet the characters of a vein arrangement have appeared every where to predominate.

The mineral deposits, whatever may be their character, are usually arranged along continued lines, having a certain direction thus forming ranges or leads (lodes.) These ranges are mostly combined, in a certain systematic order, into different groups, called diggings, between which there is a greater or less extent of country in which little or no mineral has been discovered. These groups are also connected, in a corresponding order, in more extensive series, showing the general prevalence of systematic arrangement. As little has been done in deep mining, and the deepest shafts yet sunk have been abandoned, I have had fewer opportunities than I could wish, of tracing the mineral, at the same point, through different strata. Still in several instances I have followed it without interruption, or with only such minor interruptions as are common in veins, through different strata. The mineral deposits exhibit too, in the different strata, peculiar arrangements, which are common to each throughout the mineral district, subject only to local modifications; thus showing the prevalence of arrangement in a vertical as well as horizontal order.

The ranges or leads have different directions, which preserve a great degree of regularity in the different groups or even more extended series. Three different classes of ranges are recognized, according to the direction, namely, East and West, North and South, and quartering; the last intermediate between the two former. Of these, the East and West are the most important, and

apparently have had a leading influence in the arrangement. The term East and West is not limited to such as are due east and west, or nearly so, but in different groups is applied to the predominant ranges having a general east and west bearing, although in some instances they may deviate even 45° from a due east and west course. The term North and South is also applied to ranges which deviate considerably from a due north and south course, but rarely to those which deviate more than one sixteenth. Quartering ranges (called by the miners "swithers" and "contras") include all such in a group as do not belong to either of the preceding divisions. They are such ranges as meet a leading range, particularly an East and West, at an oblique angle; consequently when the leading East and West ranges deviate from a due east and west course, a due east and west range would be considered quartering.

In general, the space in which the mineral is deposited, or through which it is distributed, if of much extent, is called an opening. This is sometimes filled with loose materials, and these by settling often leave a void between them and the roof, usually of no great extent; but in some instances large cavities, or caves, have been so formed. In other instances, the opening is merely a certain extent of the rock, more or less modified, through which the mineral is distributed. Indeed, in nearly all those instances in which the openings are filled with loose materials, these appear obviously to have been derived from the decomposition of the rock, and not from materials deposited subsequently. Such openings differ from those in which the rock is only modified, by the greater degree of decomposition the rock has undergone. The rock immediately adjoining the openings is usually harder and more compact than the rock in general. That included in the openings is generally softer and more decomposed, and more or less stained with oxide of iron. Different substances are also decomposed in it, besides the mineral, such as other metallic ores, clay, calcareous spar and sulphate of barytes.* Openings, according to their direction and the manner in which the mineral is arranged in them, are vertical, flat (horizontal), or pitching (oblique). The two first mark an important distinction in the arrangement in the different strata; the vertical openings predominating in the upper part of the upper magnesian; the flat openings in the middle and lower portions of the same, and in the blue limestone.

* Silex, in the form of quartz or otherwise segregated, except as flint, rarely accompanies the mineral, or is disseminated in the opening rock. In one of the North and Souths, at Skidmore's Diggings, a fine-grained silicious grit accompanied the sheet of mineral, as a matrix, arranged in sheet form between it and the rock; and in a brown rock opening, on the west side of Coon Branch, near Benton village, crystalline quartz was found disseminated through the opening rock, in place of the calcareous spar usually disseminated.

Although there are certain general principles which seem to have governed the arrangement of the mineral, yet numerous modifications occur, the details of which may be first given, before stating the former. In this detail, I shall commence with the arrangements observed in the upper part of the upper magnesian. The first and simplest form is that of the crevice. This may be either a joint in the rock, marked by an iron stain, or a fissure of little width, occupied by a seam of clay, or of ochre and iron rust (hematite); the two latter derived from the decomposition of iron pyrites, which sometimes, though rarely, is found in their place. Though the walls of the fissure are nearly parallel, yet it is usually marked by enlargements and contractions of little extent. In such a fissure, the mineral occurs as a sheet, either closely wedged in the rock, or separated from it by a thin seam of clay or iron. Such sheets usually conform on their surface to the adjoining substance, but occasionally present a more or less regular form, where the fissure is somewhat enlarged and the sheet is embedded in clay. They are usually less interrupted than other forms of arrangement; in some instances, very little interrupted; in others, more so, when they are called broken sheets. When interrupted, they are replaced by clay or iron ore, and sometimes by calcareous spar, sulphate of barytes or zinc ore; but very rarely by the three latter in the upper part of the upper magnesian. Calcareous spar not unfrequently interrupts the vertical sheets in the lower part of that rock, and the mineral, when in contact with it, shows the same tendency to regular forms, as when embedded in clay.* These sheets vary in thickness from a mere seam or film to a foot or more, and when even less than an inch in thickness, are generally profitable, from their little interruption, and when of great thickness, are, from the same circumstance, of extraordinary value. They may be either vertical, pitching or flat (horizontal); but the flat sheets are rather parts of a more complex arrangement, while the vertical and pitching sheets may occur separately. These last are found with all the different bearings above specified; but the north and south sheets are the most common and the most important. Not unfrequently two or more sheets are connected; the rock between them being softer and more jointed, and forming properly an opening. In such instances, more clay and iron are usually present than where a single sheet only occurs. Such sheets often unite, in their course, in a single sheet, which again divides, or are connected by cross sheets, usually in a quartering direction. In such instances, there is generally an enlargement at the junction of the sheets, where the mineral often assumes its more regular forms, and even loses its sheet character, and takes that more peculiar to the wider openings.

* The calcareous spar in such instances is sometimes distinctly crystallized, particularly in the form of dog-tooth spar.

Vertical sheets have been sometimes worked to a great extent and with little interruption, vertically as well as horizontally, and have been traced through different beds in the same instance, and in different localities have been observed traversing some of all the limestone strata above the upper sandstone. I have observed such sheets followed to the depth of 80—90 feet through different beds of the upper magnesian, and at the lowest depth still continued, sometimes increasing in thickness. Others are reported to have been followed to the depth of considerably more than 100 feet, and left still going down.*

When the crevice is of much width, and its walls are nearly parallel, it is called a crevice opening. The space, traversed by two or more connected sheets, might be called such; but the term is usually applied to an opening of a foot or more in width, in which the mineral occurs in some other form than that of a sheet. Such openings are nearly always quite vertical, but occasionally local pitches occur. The walls of such openings are rarely strictly parallel, but there is usually a series of enlargements and contractions. This tendency to enlargement and contraction is common, and is accompanied more or less by lateral cavities of different size and form. Indeed it may be said that those openings, which continue with little variation in width to a great extent, vertically or in the direction of their course, are one extreme, and that a series of isolated openings or cavities (called pockets), connected by mineral seams, such as have been mentioned, are the other, between which almost every degree of alternate enlargement and contraction may be found. Openings are more rarely found of much extent vertically than in the direction of their course. Thus in sinking on a crevice, different openings will be found, one beneath another, little interrupted in the direction of their course, but generally separated from each other by close rock, traversed only by a mineral seam, yet occasionally connected in part by long narrow crevices, or by shorter and wider passages; the last sometimes rising to a greater or less height above the upper openings, and then called chimneys. In some instances, instead of this series of openings, one beneath the other, separated by close rock, there is only a series of enlargements, corresponding to the openings, separated by alternate contractions; the crevice remaining open throughout the descent. Different ranges in the same group occasionally differ in this respect; one being marked by distinct openings, and another adjacent, only by enlargements and contractions. Different ranges are also distinguished in the same manner, in the direction of their course; the openings in one presenting a series of isolated cavities or pockets, in that direction,

* The largest North and South sheet at the East Blackleg Diggings is said to have been followed down to the depth of 140 feet, at the engine shaft, and left still going down, although with diminished thickness.

separated by close rock, marked by a mineral seam, and in another, only alternate enlargements and contractions. Whenever, in such cases, the pockets or enlargements rise to a considerable height above the range of the opening, they are also called chimneys.

These are the most usual forms assumed by the vertical openings in the upper part of the upper magnesian. They commence at different depths in the rock, sometimes near or at its upper surface, sometimes at the depth of many feet. Where the whole thickness of the upper magnesian is present, together with the overlying blue shale or pipe clay, I have never seen the crevices or openings penetrate the latter, or even the thin bed of schistose limestone, called shingle rock, sometimes overlying the thicker layers of the upper magnesian. But often the crevice is struck immediately on entering the thicker layers of that rock, and the opening soon after, and in some instances, I have observed the openings rise to its upper surface, and immediately overlaid by the pipe clay or blue shale. Where these or the upper part of the upper magnesian have been denuded, such openings reach to the surface of the rock, and are called open crevices. More generally, although the crevice may at times be struck at little depth in the rock, the opening is not reached till at a greater depth, which in each group is usually common to all the ranges. This may be called the level of the openings, and it is at this depth, known by experience in the different localities, that openings are expected.*

The openings sometimes gradually expand from a narrow crevice, but more usually terminate above in a low arch, or are flat-roofed. The rock immediately above the opening is called the cap, and when one opening lies below another, the rock separating them is the cap of the lower. It has been already stated, that the rock immediately adjoining the openings is harder than the rock generally. This is particularly true of the cap, and when in sinking on a crevice, the rock becomes unusually hard, an opening is expected.

* The crevices are not only interrupted above by the blue shale and shingle rock, but often by many feet of the upper magnesian, and are sometimes struck only at a short distance above the opening. A mineral crevice usually first shows an iron stain on its walls, and lower down a seam of clay or hematite (iron rust), and often still nearer the opening, a sheet of mineral, or detached pieces of the same in a sheet or vein position, leading to the opening. Often a seam of black ochre (oxide of manganese) precedes the mineral, indicating its near approach, and the latter, when first met, is usually more or less coated with the carbonate. Not only is it common to find a seam of clay bordering sheets and veins, or otherwise investing the mineral as a matrix, but I have observed flat-roofed or low-arched vertical openings lined by a smooth unbroken seam of joint clay, more or less completely investing them, and yet the materials enclosed, except the mineral and its immediate matrix, arranged conformably to the stratification, and apparently altered or modified portions of the rock.

The openings, now under consideration, are usually filled with soft and loose materials, which seem to have been formed by the decomposition of the rock originally occupying them. These are usually what are called sand, clay, and tumbling rock; the sand derived from the decomposition of the limestone; the clay, from that of shale or claystone; while the tumbling rock is but the harder and more compact portion of the limestone, which has resisted decomposition. In examing these materials, I have almost invariably found the sand and tumbling rock conforming distinctly, in their arrangement, to the stratification of the limestone, and the clay either arranged as distinctly in the same order, or appearing as an original matrix of the mineral.

I have already stated that the term opening is also applied to limited portions of the rock, less disintegrated, marked by certain peculiar characters, and traversed by the mineral, or through which it is disseminated. In such instances, other substances, besides the mineral, may traverse the rock, or be disseminated through it, such as other metallic ores, clay, calcareous spar, and sulphate of barytes. Iron pyrites is always originally present in such portions of rock, and has generally suffered more or less decomposition, leading to the disintegration of the rock, and to the ferruginous stain common to all openings. The limestone, in such openings, even when least altered, appears to be made up of hard compact concretions, little or not at all subject to stain or disintegrate, imbedded in a ground of more granular structure, more or less subject to stain and disintegrate from disseminated pyrites. When this part of the rock is stained, as is usual, the rock of the opening has a peculiar mottled appearance, and is called calico rock, in some localities. This is peculiarly characteristic of the flat openings in the lower beds of the upper magnesian, particularly in the flint bed. In the vertical openings in the upper part of the upper magnesian, the tumbling rock corresponds to the harder unstained nodules or concretions in the calico rock, but usually of a much larger size, and the sand to the stained and softened ground of the latter.

In the vertical openings in the upper part of the upper magnesian, the mineral, in general, is arranged vertically. In these openings, it shows a greater or less tendency to assume its regular cubic form. When its form is more regular, it is called square mineral; and when a number of cubes are combined, particularly in a sheet, it is called cog mineral. When its form is more irregular, showing only an approach to its regular cubic form, but in more or less detached masses, it is called chunk mineral.

The cubes or more irregular forms are arranged, in the vertical openings, in a certain order, more or less distinct, which may be called the *Vein order*. This is most distinct in the East and West ranges, but may be traced more or less even in the North and South sheets, where an approach to the cubic form is obser-

vable, and may be also recognized in the arrangement of the mineral in the flat openings. In this order, the cubes or masses deviate from a direct line, alternately to the right and left, forming a zig-zag, but in such a manner as to continue the general direction. When a crevice is of little width, it is usually traversed by a single vein, or course of mineral in vein order, usually accompanied by clay as its matrix. But if this be examined strictly, it will be generally found double, or divided by a middle seam into two series of cubes or less regular forms, and the same is equally true of the sheets, which, as I have observed, occasionally in the wider parts of their crevices approach the regular form of the mineral. This too is often observed where the sheets are met by cross crevices. When a narrow crevice widens, the single vein divides, each of its symmetrical parts being continued along its wall, or sometimes only one of them, the other being interrupted. The surface of the mineral next the wall is then less regular, and conforms in general to the surface to which it adheres; that towards the middle of the crevice, which is usually occupied by clay, is more regular; the whole vein, in this instance, forming a more or less perfect geode. Where the crevice alternately widens and contracts, the same alternation will be observed in the arrangement of the vein. Such geodes or more irregular deposits, in the enlarged portions of the vein, are called bunches. In some veins there is a greater tendency to form bunches than in others, and in such cases the intervening portion of the vein is usually diminished or even interrupted. The arrangement of the vein thus corresponds to that of the openings.

Where the opening is wide, and includes considerable masses of tumbling rock, it may contain several such veins or courses of mineral, separated by the masses of rock, which may either unite, or be connected by smaller cross veins. Sometimes the wider vertical openings are traversed longitudinally, to a greater or less extent, by one or more vertical masses of rock, called key rocks; but these rarely divide the openings completely, but are more or less insulated, corresponding to the horses of English miners. These are particularly connected with an important arrangement observed, in several instances, in the upper part of the upper magnesian. This occurs, when, in a wide opening, with a flat or slightly arched roof or cap, the lower part is chiefly occupied by one or more key-rocks, rising towards the roof, but leaving an interval of greater or less width above. Veins of mineral rise in the intervals between the walls and key-rocks, or between the key-rocks themselves, and pass over the top of the key-rocks in the manner of a flat sheet; the whole being thus connected. Some of the heaviest bodies of mineral have been found thus arranged. The lead struck about a year since, at Turner's Diggings, east of the Sinsinawa Mound, and one of the most productive for the time it has been worked, is of that kind. In some

few instances, large bodies of mineral have been found on the surface of the rock, where it had suffered denudation, lying between two vertical veins in the rock; apparently resulting from such an arrangement. A remarkable instance of this kind occurred at Selkirk's Grove, west of Benton village, and a similar body of mineral was found in a ravine, near the lead at Turner's, lying on the surface of the rock, on one side of which at least a vertical vein was seen entering the latter.

An analogous arrangement is observed in the wide openings, called caves, remarkable instances of which occur in the Dubuque district. Veins rise there along the sides, and are continued upwards into the sides of the roof, and at the same time send flat sheets along the roof, the two from the opposite sides meeting at a middle crevice in the roof, and sending up through it a vertical vein, which often presents a geode as it enters the crevice, as if formed by the junction of the two. In one instance, where a cross section of the roof was exhibited (at Stewart's cave), the lateral vertical veins sent across other flat sheets through seams in the cap-rock to the middle vertical vein. The flat sheets, crossing under the roof and in the rock above, are generally thinner and more interrupted near the middle point between the side and middle vertical veins; a fact generally observable in flat sheets interposed between vertical veins, as if the formative action proceeded from the latter.

In some instances, in wide openings, where no key-rocks are present, an arrangement similar to that in the roof of Stewart's cave is observed in the soft ground of the opening itself; flat sheets not only extending across under the roof, but at intervals below; the opening being then occupied by decomposed rock, arranged conformably to the stratification. Sometimes the flat sheets extend only a short distance from the side veins, and in other instances, the side veins rise only partly towards the roof, and terminate in flat sheets extending but partly across the opening. In one instance, in such a wide opening (at the east end of Hughlett's lead, north of Galena), a layer of hard rock was interposed in the soft ground in the lower part of the opening, as if dividing it into an upper and lower, below which a flat sheet extended across the opening, while the lateral vertical veins were continued uninterruptedly on its sides.

The same vertical opening sometimes presents different arrangements in different parts of its course; in one part, only a single vertical vein, occasionally enlarging into bunches or geodes; and in another part, arrangements such as have been last described; the opening enlarging and varying in form correspondingly. Thus a wide cave opening will sometimes pass at no great distance into a narrow crevice opening, and the arrangement of the mineral will change from that of lateral vertical veins, meeting by cross flat sheets in the roof or below in the

opening, to that of a single vertical sheet or vein. This latter will, in some parts of its course, form a proper sheet; in others, a vein marked by cubes, more or less distinct, in regular vein order; and in others, geodes or bunches, and these last either connected by intervening sheets or veins, or more or less detached and interrupted. In the latter case, however, the connection may be traced by a mineral seam, more or less distinctly marked.

I have already observed that the same crevice sometimes includes distinct sheets or veins, occasionally uniting in one, or connected by cross sheets or veins. In like manner, distinct crevices, with their veins, sometimes unite or are connected by cross crevices and veins. At such points of junction, there is usually an extraordinary increase of the mineral, and the smaller vein is then regarded as a feeder of the larger. The East and West veins are usually the leading veins, and the North and South and quartering veins are then subordinate and regarded as feeders. But usually where cross veins meet a leading vein at such an accumulation or bunch of mineral, they extend only a limited distance from it, and are rather lines proceeding from it as a centre than feeders contributing to form it. When a quartering vein meets a leading vein, on entering the crevice of the latter it often runs parallel to it for some distance, the two connected by a net-work of cross-veins, and at last uniting in one common vein. In some instances, two parallel leading veins are connected by such quartering veins, and in others, one leading vein will leave its regular course, and pursue a quartering direction till it unites with a leading vein adjoining. Cross veins are differently affected on meeting a leading vein. Sometimes they pursue the same course, without interruption, on the opposite side, but more usually they are interrupted (cut off), or else shifted to a greater or less distance. In the latter case, I have sometimes observed particles of mineral disseminated in the rock opposite the vein at its junction with the leading vein, apparently indicating that the shift was not caused by any shift in the rock, of which there were besides no indications. Not unfrequently a leading vein, on meeting a cross vein, will be interrupted or cut off, with its crevice, and apparently shifted by the cross vein to another parallel vein. In one instance, I observed an East and West vein, from which a quartering vein had proceeded at some distance, interrupted in this manner by a North and South, and apparently shifted by it to the quartering vein, when the latter became the leading East and West vein. In other instances an East and West vein will terminate less abruptly, and be shifted to another east and west line, commencing there in the same manner it had terminated; the two overlapping each other to some extent, and sometimes connected by a cross vein or seam near their termination. Usually the cross vein, in such cases, is small, and serves only as a leader from one East and West vein to the other, or

the connection is formed only by a seam of ochre or clay. These arrangements have an important relation to the grouping of veins, and will be farther noticed under that head.

Another mode of lateral shifting is sometimes observed in East and West vertical veins, where the mineral is arranged in a series of more or less detached deposits or bunches. These last range in a direction oblique to the general course of the vein, and usually thin out at each extremity. Each succeeding bunch overlaps the preceding in such a manner that the general course of the vein is continued.

The mineral in the vertical openings is sometimes found only near their cap or roof, and sometimes only in their lower part; sometimes both above and below, but not between; and at other times, more uniformly throughout their whole depth. Not unfrequently it rises and falls alternately in its course, occupying only a moderate extent vertically at any one point, but rising and falling to a much greater. The opening, when it is low and capped over with hard rock, rises and falls, in such cases, with the mineral. This rising and falling is usually by a succession of flats and pitches, or steps, rather than on a uniform line. A similar arrangement occurs in the flat openings in the lower beds. Often the mineral rises above the common level of the openings in the chimneys already described (p. 8–67); in such cases forming bunches at the intersection of the chimney with the horizontal opening, extending upward into the former.

Flat (horizontal) sheets or veins have been already noticed in connection with the wider openings, both in the soft ground of the opening, and in seams in the cap rock. In some instances, such flat sheets have been observed, of considerable extent, overlying a number of parallel crevices traversed by vertical veins, and in others, of less width, overlying only a single opening or vein. When such a sheet is struck in the upper part of the upper magnesian, it is considered as indicating the near approach of an opening or vein.

More usually, in the upper part of the upper magnesian, the East and West ranges present vertical openings of some width, traversed by veins composed chiefly of square (cubic) or chunk mineral, arranged in the vein order above indicated, while the North and South ranges are only narrow crevices traversed by sheets, marked only rarely by an approach to regular forms. But in some instances, similar sheets traverse East and West crevices, and these are often combined in groups, intervening between or appended to the larger East and West openings. Sometimes a considerable width of rock is found traversed, at short intervals, by such vertical East and West sheets, connected throughout by cross sheets, both vertical and horizontal. These cross sheets, in such cases, are usually thinner and more broken, or even quite interrupted, at the middle point between the East

and West vertical sheets, indicating that the latter are the leading veins, to which the former are subordinate. The rock thus traversed is usually softer and more stained, at least towards its seams, and may be considered as forming one common opening.*

In the upper part of the upper magnesian, the crevices and openings are usually of less width and more detached than below, and the leading veins arranged vertically, the flat sheets being only appendages to them. The openings, even when widest, such as the large cave openings, are also more generally occupied with looser materials, from a greater decomposition of the rock and matrix. As we descend to the lower part of the upper bed, the openings become wider, although in most instances the vertical arrangement continues to prevail. In this part of the upper bed, very wide openings are found, occupied by portions of the limestone rock, either decomposed to sand, or in detached harder masses (tumbling rock,) and intersected throughout in different directions by mineral veins, usually accompanied with seams of clay and iron; the East and West vertical veins predominating. The mineral in these veins is usually in more or less detached masses (square and chunk mineral,) but sometimes in thinner sheet forms, usually broken. In some instances at least, those remarkable bodies of mineral, called patches, found directly beneath the surface clay, appear to have been such openings exposed by denudation. Those to which I here refer are no longer worked, but are found in the same position in the strata, and in some instances, in the vicinity of such openings, and from the description I have received, corresponded to them in character.†

Another class of wide flat openings, called flat sheet mines, are found in this lower part of the upper bed. Here the horizontal arrangement predominates; the mineral having a sheet form, similar to that of the vertical sheets, and closely wedged in the rock, or more usually in a narrow flat crevice, in which it is bordered by seams of clay or iron, and occasionally interrupted by the same, or by calcareous spar. These flat sheets appear more subject to interruption than the vertical sheets, and then often form a series of lenticular masses, thickest at their centre and thinning off towards their edges. They vary, like the vertical, in thickness, from a fraction of an inch to several inches, and are connected by cross vertical sheets, in different directions, which are small and subordinate; but occasionally the flat sheet gives out as it approaches a vertical sheet, and the latter assumes the place and direction of the former. Two and sometimes three such flat sheets are connected together in this manner, the rock

* An example of this occurs in one of the ranges of Norris & Haskins, at Vinegar Hill.

† The Finney Patch, in the S. W. Platteville Diggings, and Jones's range, N. of Elk Grove, may be referred to as examples.

between them being softer and more stained than that immediately above and below, forming properly a flat opening, but not marked by the peculiar characters of the opening rock in the flint bed below.*

In some instances, when from the vicinity of valleys or ravines, or in deep mining, shafts have been sunk through the upper bed into the flint bed, as at Shullsburg, vertical crevices have been traced down through the former into the flat openings in the latter. In such cases, in the lower part of the upper bed the vertical openings spread out laterally, and at the same time that they carry down a vertical vein, in the middle line, from the crevice above, present flat deposits of mineral, similar to those in the flat openings of the flint bed, but less extensive; thus marking a transition from the vertical openings above to the flat openings in the lower beds.

The flat openings in the flint bed are remarkable for their horizontal extent and their arrangement. They vary in width from less than ten to 40—50 feet, and are wider in some localities than in others. Generally they are traversed by vertical crevices, marked by seams and sometimes by openings in the roof, but these are sometimes wanting, and the vertical crevices are then found traversing the hard rock between the flat openings. Thus it is common at Benton, to find narrow vertical crevices between the wide flat openings, and these last are sometimes arranged in pairs with a vertical crevice between; the interval separating the two being much less than that separating them from the flat openings adjoining. The two thus combined, with their intermediate crevice, are considered as forming one range. In one instance (at Shaw's Hollow, S. W. of Benton), a wide flat opening, without a vertical crevice, adjoined on the north a number of narrower flat openings, each with its vertical crevice; but in this instance, the whole extent, at least of the latter, might be regarded as one common opening or soft ground. The rock in these flat openings usually presents a peculiar mottled appearance, whence it is called calico rock in some localities. The cause of this I have already referred to. This rock appears to have resulted from the decomposition of a hard blue or gray rock, intersected more or less completely by seams of iron pyrites, or rather of rock more or less filled with disseminated pyrites, dividing it into small rounded nodules, more compact than the intervening seams. This structure cannot have been derived from the fracture of the rock and the injection of the seams, but has been the result of a process of segregation, by which the more compact limestone was formed at centres, around and between which the more crystalline portion with the pyrites was arranged. The

* Examples: Harris's flat sheet mine, S. W. of Galena, and Jackson's, on Bull Branch (Benton).

strong tendency of iron pyrites to decompose, under certain circumstances, particularly when minutely disseminated, has caused the disintegration of the limestone in which it was dispersed, and its own conversion into oxide of iron, giving the stain to that part of the limestone. This hard blue pyritiferous rock is still found unchanged, in some of the flat openings in the flint bed, as in Champion's level (New Diggings), where it occupies the position of the opening or calico rock, and like that is more or less productive in mineral similarly arranged.

The mineral in the flat openings is generally arranged in horizontal courses adjoining the roof or the floor, but sometimes in intermediate positions. Sometimes it forms a connected sheet of some extent, but more usually occurs in larger or smaller detached masses. These are generally more or less convex on one side and concave on the other, and are so arranged that the convex side is directed downwards. The concave side usually embraces a portion of the limestone harder and less stained, and sometimes the mineral is observed more or less completely surrounding the latter, but much thicker below than above. In this case, the mineral appears to have been formed around the nucleus of limestone in the same manner as the iron pyrites, as above explained. The courses of mineral are very often if not generally accompanied with a layer of flints, usually above the mineral, sometimes below, and occasionally the mineral is interposed between two layers of them. Sometimes the mineral, when detached and isolated, is associated with flint in the same manner. Though the mineral is chiefly arranged in flat courses, yet it is often found detached in every part of the opening, but is then arranged horizontally.

(To be continued.)

Art. III.—The Relations of the "New Red Sandstone" of the Connecticut Valley and the Coal-Bearing Rocks of Eastern Virginia and North Carolina.—By Prof. W. B. Rogers.*

Prof. W. B. Rogers exhibited a series of fossils from the middle secondary belts of North Carolina, Virginia, Pennsylvania, and Massachusetts; chiefly, he said, with the view of calling attention to the evidence afforded by some of them, of the close relation in geological age between what has been called the New Red Sandstone of the Middle States and Connecticut Valley, first designated by Prof. H. D. Rogers as the Middle Secondary Group, and the coal-bearing rocks of Eastern Virginia and North Carolina.

* Proc. Boston Soc. Nat. His. 1854.

Prof. Rogers referred to the existence in Virginia of three distinct belts of these rocks. The most eastern of these, extending almost continuously from the Appomatox River to the Potomac, includes the coal fields of Chesterfield and Henrico Counties. The middle tract, about twenty-five miles west by south of the preceding, is of much less extent, and has not yet furnished any workable coal seam. Somewhat intermediate in trend to these is a belt of analogous rocks in North Carolina, commencing some distance south of the Virginia line and stretching south-westwardly across the State, and for a few miles beyond its limits, into South Carolina. This area, first mapped by Prof. Mitchell, includes the coal-bearing rocks of Deep River. The western belt extends, with two considerable interruptions, entirely across Virginia, being prolonged towards the south-west in the course of the Dan River in North Carolina, and towards the north-east through Maryland, Pennsylvania, and New Jersey, forming what is usually called the New Red Sandstone Belt.

Eastern and Middle Belt of Virginia and Eastern Belt of North Carolina.—From an examinaton some twelve years ago of the fossil plants of the most eastern of the Virginia belts here designated, Prof. Rogers had been led to refer this group of rocks to the Oolite series on or near the horizon of the carbonaceous deposits of Whitby and Scarborough in Yorkshire. Some years later he discovered many of the same plants in the middle belt of Virginia, and, in the summer of 1850, he found several of these plants in the coal rocks of Deep River, in North Carolina. In each of the latter districts we meet with Equisetum columnare, Zamites, and a plumose plant referred to Lycopodites, and strongly resembling L. Williamsonis of the Yorkshire rocks. These are among the usual forms occurring in the easternmost of the Virginia belts.

Besides the fossil plants common to these three areas, they contain two species of Posidonomya and two of Cypris. Of the Cypridæ, one species has a smooth, the other a beautifully granulating carapace. They are both very small, seldom exceeding $\frac{1}{35}$ an inch in length and $\frac{1}{75}$ in width. Both species of Posidonomya differ in proportion from the *P. minuta* of the European Trias, but one of them strongly resembles the *P. Bronnii* of the Lias, although of larger dimensions.

Prof. Rogers remarked upon the uncertainty which exists as to the true nature of the small shell-like fossils, which being assumed as molluscs, have been referred to Bronn's genus Posidonomya. But, whatever may be their zoological affinities, the fossils now under consideration have great interest, as affording further means not only of comparing together the mesozoic belts of North Carolina and Virginia, above referred to, but of approximating more justly than heretofore to the age of the so-called New Red Sandstone, or Triassic rocks which form the prolonged belt lying further towards the west.

In the report of Prof. Emmons, published in the autumn of 1852, mention is made of the remains of Saurians in the Deep River deposits, as well as of the Posidonia and Cypris, and of an Equisetites, a Lycopodites and other allied forms, together with a naked, rather spinous vegetable, regarded by him as a cellular cryptogamous plant.

In view of the general identity of the fossils thus far found in the Dry River and Middle Virginia belts, with those of the most eastern deposits in Virginia, viz., that including the coal of Chesterfield, Prof. Rogers maintained that the general equivalency of these three areas may be regarded as established, and therefore the Dry River belt of North Carolina, as well as the Middle Virginia belt, ought to be placed in the Jurasic series, not far probably above its base.

Western belt of North Carolina and Virginia and its extension towards the North-east, forming the so-called New Red Sandstone of Virginia, Pennsylvania and New Jersey, and probably of the Valley of the Connecticut.—In North Carolina, on the Dan River, where the rocks include one or more thin seams of coal, the same Cypridæ or Posidoniæ are found in great numbers in some of the fine-grained shales and black fossil slates. The latter were noticed as early as 1839, by Dr. G. W. Boyd, while on the Virginia Geological Survey. Regarding this fossil, of which specimens were also obtained about the same time from the middle belt in Virginia, as identical with the Posidonia of the Keuper, Prof. Rogers had, many years ago, announced the probability that a part or all of the great western belt was of the age of the Trias, instead of being lower in the Mesozoic series.

Specimens of the Posidoniæ and Cypridæ, from both belts in North Carolina, and from the eastern and middle belts in Virginia, were exhibited by Prof. Rogers at the Albany meeting of the American Association o Science, in 1851, for the purpose of showing the close relationship between these deposits, in geological time. Among the specimens from the Dan River, Prof. Rogers on the present occasion referred to the impression of a Zamite leaf and a joint of Equisetum columnare. Prof. Emmons, in the report above referred to, speaking of the marly slate of this system, says that "It differs in no respect from that of Deep River, bearing the same fossils, Posidonia and Cypris, in great abundance."

In the belt in Virginia, toward the Potomac River, Prof. Rogers had lately found immense numbers of the same Posidonia and Cypridæ, crowded together in fine argillaceous shales, and at several points he had met, in the more sandy rocks, vegetable impressions, which, although obscure, are strongly suggestive of the leaves of Zamites.

In the same belt in Pennsylvania, in the vicinity of Phœnixville, early last spring, Prof. H. D. Rogers discovered Posidoniæ in great numbers in a fissile black slate, and on subsequent ex-

amination, the same beds were found to contain layers crowded with the casts of Cypridæ. Along with these are multitudes of Coprolites apparently Sorian, resembling in size and form the Coprolites found in the carbonaceous beds on Deep River, and also some imperfect impressions of Zamites leaves. These facts Prof. Rogers considers sufficient to identify, as one formation, the disconnected tracts of this belt in North Carolina and Virginia, and the great, prolonged area of the so-called New Red Sandstone of Maryland, Pennsylvania, and New Jersey.

As to the geological date of this belt, Prof. Rogers said that the discovery at various and remote points of its course of Posidoniæ, Cypridæ, and Zamites, most or all of which are identical with these forms in the eastern middle secondary areas of Virginia and North Carolina, makes it extremely probable that these rocks, formerly referred to the New Red Sandstone, and of late more specially to the Trias, are of Jurassic date, and but little anterior to that of the coal rocks of Eastern Virginia.

Prof. Rogers considered the frequent occurrence of Cypridæ in all these belts as a strong evidence of their Jurassic age. While only a few species of Cypridæ, and many of the allied genus Cytherina occur in the silurian and carboniferous rocks, there is a total absence of these crustacean remains throughout the series of deposits extending from the base of the Permian to the lower limits of the Oolite. But on entering the latter, the Cypridæ reappear, and become very abundant there, there being no less than twelve species known to belong to the Oolite formations of Europe.

On comparing the solidified wood, found in the western and eastern belts, Prof. Rogers had found its structure to be the same, and to agree very nearly with the fossils figured by Witham under the name of Peuce Huttonia. As this particular structure does not appear to have been met with below the Lias, and occurs in that formation, it furnishes another argument in favor of the Jurassic age of all these rocks.

Prof. Rogers added, that he had not found in the New Red Sandstone of the Connecticut Valley either the Posidonia or Cypris, although he had met with obscure markings which he was inclined to refer to the latter. He had however satisfied himself that one of the plants, from the vicinity of Greenfield, in Massachusetts, was identical with the form in the Virginia coal rocks referred to Lycopodites, and probably *L. Williamsonis;* and that among the other very imperfect impressions associated with this, was one which he regarded as the leaf of a Zamites.

On the whole, therefore, Prof. Rogers concluded that the additional fossils from the coal-bearing rocks of Virginia and North Carolina served to confirm the conclusion of their being of Jurassic date, and that the fossils, thus far found in the more western belt, and its extension through Pennsylvania and New Jersey, rendered it proper to remove it from the Trias and place it also

in the Jurassic period, a little lower probably than the eastern belt of North Carolina and Virginia; and there could be little doubt, he thought, that the same conclusion would apply to the New Red Sandstone of the Connecticut Valley.

ART. IV.—THE MARLS OF NEW JERSEY.*—BY PROF. GEO. H. COOK.

THAT part of New Jersey, which in the Geological Survey is assigned to the southern division, includes all that portion of the State lying south of a line drawn from Staten Island Sound, near Elizabethport, to the Delaware River, a little below Trenton. The line follows the south-eastern border of the red shales and sandstones which stretch across the central part of the State. Its general direction is straight, and its bearing a little west of south-west. The extreme length of the district is one hundred and ten miles, and its greatest breadth about seventy-five miles. Its area is estimated at not far from three thousand four hundred square miles.

In its physical geography, it is remarkable for its lack of hills, its sandy soil, its extensive pine woods, and for the almost entire absence of rocks.

The Nevisink Hills are three hundred and ten feet high,† and a chain of hills of a somewhat less elevation extends from them in a westerly direction to Freehold. South of these the country seldom rises more than sixty feet above the level of the sea.

A belt of clayey or loamy soil, several miles in width, extends across the northern border of the district, and down the Delaware River to the Bay; and streaks of clayey soil are generally found on one or the other of the banks of the stream running into the Atlantic. With these exceptions the soil is a light sand, and extensive tracts of it are still covered with pines and scrub oaks.

A kind of cemented gravel or pudding-stone, firm enough to be used for the commoner purposes of building, is found in some of the higher hills, and then layers of limestone, which can be burned into lime, are found in a few places; but solid beds of rock are nowhere met with.

"The whole of the district is tolerably well watered; but the streams are neither large nor rapid, and are remarkable for the depth of their beds, which cause, indeed, almost the only inequalities in its surface." "Most of the streams have crooked courses, and flowing through a flat country, are commonly navigable some miles from their mouths. Unlike the rivers of hilly countries, they are steady in their volumes, and uniform supplies of water can be more confidently relied upon."‡

* Report on Geological Survey.
† See Gordon's Gazetteer, p. 1.
‡ Gordon's Gazetteer.

There being but little water power, manufacturing is not carried on to any considerable extent. Deposits of bog iron ore are found, and a small amount of iron is made from them; and there is an abundance of excellent sand for glass making, which, with the cheapness of fuel, has caused the establishment of numerous glass-houses. The principal business of the inhabitants is agriculture. In this remarkable advances have been made within a few years. In 1834, Gordon says, "an immense forest covers probably four fifths of this district, and forty years ago it was not worth more than from six to ten cents an acre. From this they have risen to an average price of six dollars an acre."

The following statement, compiled mostly from the United States Census of 1850, shows nearly its present condition:

COUNTIES.	FARMS IN ACRES. Improved.	Unimproved.	Average Value per acre.
Half of Mercer	81,798	7,196	$54.18
Half of Middlesex	57,969	21,058	41.21
Monmouth	145,739	82,440	50.40
Ocean	26,466	28,887	19.86
Burlington	132,017	40,670	67.56
Camden	53,968	77,416	35.40
Atlantic	15,006	34,585	13.80
Gloucester	68,810	52,897	37.37
Salem	105,956	38,942	45.88
Cumberland	48,469	71,646	22.10
Cape May	14,310	37,653	15.87
Total	700,503	492,885	Mean, 41.70

The following table, compiled from the same sources, will furnish data for comparison with the whole State, and also with the neighboring States:

STATES.	Area in acres.	FARMS IN ACRES. Improved.	Unimproved.	Average value of farms per acre.
Massachusetts	4,640,000	2,133,436	1,222,576	$32.50
Connecticut	3,040,000	1,768,178	615,701	30.50
New York	29,440,000	12,408,968	6,710,120	20.00
New Jersey	4,884,640	1,768,991	984,955	43.67
Pennsylvania	30,080,000	8,628,619	6,294,728	27.33
Delaware	1,356,800	580,862	375,282	19.75
Maryland	7,040,000	2,797,905	1,836,445	18.81

In these tables the improved lands include only such as produced crops; the unimproved such as did not produce crops, but were connected with the farms. Unoccupied land is not included under either of these heads.

A comparison of the first and second table shows, that while the value of the land in farms is a little less in the southern division than the average of the whole State, it is still greater than that of any other State mentioned, and it is greater than that of any other State in the Union. I have not been able to ascertain the areas of the counties separately, and cannot give the amount

of land in farms, compared with that still unoccupied. But if we suppose one half of the State to be in the southern division, a little more than one half its area must be in farms, which is less than in Massachusetts, Connecticut, New York and the northern half of New Jersey, and greater than in Pennsylvania, Delaware and Maryland.

The climate is mild or even warm, and the early springs and light soils enable the farmers to furnish the first supplies of garden produce to the markets of New York and Philadelphia, and a large part of such supplies for those cities is drawn from New Jersey. Of other crops, Indian corn and potatoes are raised in largest quantities. Wheat, rye, oats, and sweet potatoes are extensively cultivated. The average of live stock is much above the average of our country.

The rapid advance of agriculture in this district is due in part to its location, in part to the improvement of the country generally, but more is to be ascribed to the use of a kind of marl which is found here in immense quantity. The belt or strip of land under which this is found lies obliquely across the State from Sandy Hook Bay south-west to Salem. Its length is about ninety miles, and its breadth fourteen miles at its eastern extremity, and six miles at its western. Its area is nine hundred square miles, or five hundred and seventy-six thousand acres; and its benefits are shared by a considerable district of country lying on each side of it, so that the whole area improved by it is swelled considerably beyond the above amount. It has been worth millions of dollars to the State in the increased value of the land and produce, besides the influence it has exerted in awakening and fostering a spirit for agricultural improvement. Requiring labor and not money from those who would enjoy its benefits, it has been found admirably adapted to encourage and reward enterprising industry.

The attention of men of science has been frequently called to this interesting formation, on account of its value in agriculture, and also for its numerous and remarkable fossils; bones, shells, shark's teeth, &c., being common on it. Its geological character was first distinctly shown by Professor L. Vanuxem, Dr. Morton, and Mr. Conrad, of Philadelphia, in eighteen hundred and twenty-seven. In eighteen hundred and thirty-five, the legislature ordered a geological survey of the State to be made. This was done by Professor H. D. Rogers, and his final report was presented in eighteen hundred and forty. This report included a very full account of the marl, both geological and chemical. Numbers of analyses of the varieties of it have been made by other chemists; some of these are important, and will be referred to again. Under such circumstances, the present examination was entered upon with a good deal of distrust; and nothing but a knowledge that the openings into the marl were much more numerous and extensive than when Professor Rogers closed his survey, and that thus

an opportunity for study was now presented, which was not then available, could have induced an attempt to re-examine what had already been so well done.

DESCRIPTIVE GEOLOGY.

From examinations in the field, the following facts are proved:

1. The clays and marls, which constitute the basis of most of this part of the State, are in regular and continuous layers.

2. These layers are not level, but incline or *dip* towards the south-east. They have been observed to descend from twenty to fifty feet in a mile.

3. Since these layers were formed, the action of water, or other causes, has worn away and changed the surface of the country.

In passing across the country from the north towards the south, we come upon the different layers in orderly succession; in examining the pits which have been opened for marl, the successive layers are always found in the same order; examinations upon the sides of hills where they have been cut into, show the same order that is found in the lower grounds to the south of them; and the same fact is observed in the banks of streams which cut through the layers.

From the fossils found in these beds, geologists have determined that the marls and the clays north of them, and between them and the red sandstone, belong to the cretaceous or chalk formation,* and that the beds on the southern border of the marl belong to the tertiary. The sands and some of the clays south of these, are probably of more recent origin.

The general principles stated above, are all exemplified in Eastern Monmouth; the clays are found on its north side, the marls across the centre, and the sands on the southern side.

I. The clays occupy the county between the north-west line of the county and the northern sides of the hills which extend from the Nevisink to Mount Pleasant, and on to near Englishtown. On the shores of Sandy Hook and Raritan Bay, the clay is thickly covered with sand. In the valleys between some of the hills mentioned, it extends considerably further south. It is almost black when wet, but is gray when dry. It contains a good deal of micaceous sand. The trunks and branches of trees, in the form of lignite, are found in it in great quantities, and frequently associated with sulphuret and sulphate of iron. Ir-

* A "formation," in geology, is "that collection or assemblage of beds or layers, strata or portions of earth or minerals, which seem to have been formed at the same epoch, and to have the same general characters of composition and lodgment." (Webster.) In this report I will use the terms stratum, bed and layer, for the successive subdivisions; thus dividing the formation into "strata," each stratum into "beds," and each bed into layers.

regular streaks of green marl are also found in it; in some places enough to make it valuable as a manure. Characteristic fossils are also found. The examinations made thus far have not been sufficient to furnish precise descriptions of the position or qualities of the different layers or even of the beds of this stratum.

II. The marls are found in various parts of the country from the south line of the clays to a line drawn from the Atlantic shore, near Great Pond, in Deal to the Manasquan River, between Upper and Lower Squankum.

The substance here called marl, is not the ordinary calcareous clay or earth, which is distinguished by its light color and its effervescence with acids, but is a kind of earth, most of which is in little rounded grains, about the size of fine gunpowder; its color is usually some shade of green; the crushed grains are always green; and they are so soft that they can easily be crushed on the nails; they scarcely effervesce with acids. Besides the grains in the marl, there is generally a little white sand and some clay; the latter being of various shades of black, brown, drab, or green, and so mixed in it as to give color to the whole; great numbers of shells are found in some of the layers; these of course cause the marl to effervesce. The marl grains are known in geology as *greensand.*

Though the whole series of beds which is exposed in the district now under examination, is called the *marl stratum*, yet marl grains are not found in all the beds, some of them consisting entirely of sand, and others of clay.

There are three distinct beds of marl in the stratum: the *first* includes those found north of the north branch of Shrewsbury River, Swimming River, and Yellow Brook; also those found on the head-waters of South River, north of Freehold. A few pits have also been opened below tide level at Red Bank. The *second* includes those near the head of the south branch of Shrewsbury River; those near Eatontown; those along the valley of Hockhockson Brook, above Tinson Falls; those a little south of Colt's Neck Village; those about a mile and a half south of Freehold, and those south of Blue Ball: it also includes the yellow marls south of Eatontown and about Long Branch; the same bed is also found near the tops of the hills south of Red Bank and that south of the Phalanx Dwellings, and I think in some of the highest points of the Nevisink Hills. The *third* bed includes the marls of Deal, Poplar, Shark River and Squankum.

The bed of yellow ferruginous sand which is so conspicuous a feature in the soil of the Nevisinks, at Red Bank, at Colt's Neck, and indeed entirely across the State, lies between the first and second beds of marl.

A bed much resembling beach sand, with a very few marl grains scattered through it, lies between the second and third marl beds.

The several beds of marl are each made up of distinct layers, which vary in appearance and in properties.

In the first bed five distinct layers may be recognized.

1. A layer of sand and fine gravel, from two to four or more feet in thickness. This is very distinctly separated from the clay which lies immediately under it. It contains numerous fossils, a considerable portion of marl grains, and is valuable as manure. It is known as *sand marl.*

2. A layer of nearly pure marl grains, of variable thickness, averaging perhaps four feet. A little blackish clay is mixed with marl, from which it is generally known as *black marl.* It contains but few fossils. As a manure it is highly prized. Though always found, it is not very distinctly separated from the next layer.

3. A layer of from twelve to sixteen feet in thickness, known as *blue* or *gray* marl, from its containing a considerable amount of a drab-colored clay, inclining to bluish or grayish. It has numbers of very large and heavy oyster shells in it—generally there is a streak from eight inches to two feet thick, which is almost solid with shells. This layer is very highly prized as a quick and lasting fertilizer. It changes gradually into the one next above.

4. Three or four feet of *black marl,* almost exactly like that of No. 2. It is not found distinctly marked in all places.

5. Dark-colored marl six or eight feet thick, containing fewer and fewer of the marl grains in its higher parts, and at last only to be distinguished from the dark clay into which it runs, by the thin flaky shells scattered through it.

The thickness of this bed of marl is at least thirty feet. The whole can be seen in the side of the Nevisink Hills on the shore of Sandy Hook Bay. They have all been passed through in the pits of the North American Phalanx, and Mr. William Hartshorne had them bored through for me in his pits north of Freehold. All except the top layer is well exposed in the pits of Wm. Conover, near Marlboro'. And they can be seen in succession, by passing along the valleys of any of the streams which run through the marl, as the Spottswood north and south branches of South River, and in the Hop Brook from Taylor's Mill to Marlboro'.

The following circumstances may produce a little difficulty, at first, in verifying the preceding statements. Whenever the clay, which lies immediately over this bed of marl, has been worn away, and the marl lies above the bed of neighboring streams, the rains and surface water penetrate it, to a greater or less depth, and leach off; dissolving out the fossils and leaving earth in their places; changing its color to a rusty red; and forming numerous flaky crusts, or sometimes strong cakes of impure oxide of iron, in it. Such marls are called *dry bank* or *hill* marls. These

changes have taken place to a much greater extent in some localities than in others. Marls which lie so as not to be subject to the action of surface water, or drainage, are called *wet bank* or *meadow* marls.

The characteristic fossils of this bed are Exogyra costata, Gryphaea convexa, Ostrea falcata, Terebratula sayii and Belemnites americanus. A great many others are found, but they are not so numerous and not so generally present in all localities.

Lying immediately upon the bed of marl which has just been described, and not separated from it by any well marked division, is a layer of black clay. It contains scales of mica and grains of sand. In small quantities it cannot easily be distinguished from the stratum below the marl. It frequently contains sulphate of iron (copperas); and being often mistaken for marl, has been used to the injury of the farmer. When composted with quicklime it is thought to be useful. It is from ten to twenty feet thick.

The red or ferruginous sand lies upon the clay just mentioned. It is separated from it by a well marked line of division. This bed is of great thickness; not less than one hundred feet at Red Bank, and in the Nevisinks it is equally thick. Whenever this sand has any degree of firmness it is full of the impressions and casts of shells and other fossils. The lower part of this bed is a very friable sand; towards its upper part a greenish clay is found mixed with the sand, giving to it a good degree of firmness; the rock at Tinton Falls is an example of this. The upper part of this bed, from four to six feet, is a layer of greenish indurated clay, in some places hard enough to be called a rock. It slakes on exposure to the weather. No marl grains are found in it; but it is called marl by many farmers, and is profitably used as such.

The *second bed* of marl is not so extensively developed in this part of the country as the first one; though it is considerably thicker. Its several layers may be described as follows:

1. A layer of marl containing but very few fossils; its lower part almost clean grains; clay is mixed with the grains in the upper part, in many localities. The color of the grains in this layer, and indeed in the whole bed, is green with a shade of yellow, unlike those in the first bed, in which the color is green, with a shade of black or dark blue. I have not in any place in this part of the county found the layer worked more than fourteen feet, though I believe it to be much thicker. In the pits of Mr. Imlay, on Crosswicks Creek, a short distance below New Egypt, it is nearly twenty-five feet.

2. A layer of from ten to fourteen feet of marl, with numerous shells. A streak in the upper part of this, for two or three feet, is almost solid with shells of the Terebratula harlani; and another layer near the bottom of it is equally solid with shells of the Gryphaea convexa. This layer gradually loses its marl grains, at the upper part, and runs into

3. A layer of broken shells with more or less sand intermixed, and containing scarcely any marl grains. The color of this marl is *yellow* or *gray*. In the neighborhood of Eatontown it is called *yellow marl.* No localities have been visited in Eastern Monmouth where it has been penetrated more than fourteen feet, but near Salem it has been opened for more than twenty feet.

There are no good localities where all these layers are to be seen together. The nearest approach to it is in the pits of Mr. Strickland, near Blue Ball, where the top of the first, the whole of the second, and the bottom of the third layers are shown. The meeting of this bed and the clay of the sand bed under it is well shown in the marl pits of J. S. Trafford, Daniel Polhemus, and John S. Cooke, above Tinton Falls. Also in the pits of Mr. Lafetra and Mr. Lippincott, on the north side of Parker's Creek, near Eatontown. The *yellow marl* is dug near the Turtle Mill at Long Branch. Also by Dr. Lewis and others, of Eatontown. The bottom of Edward Wolcott's marl, near the latter place, cannot be distinguished from the top of Strickland's.

A large number of species of fossils are found in these different layers. Those mentioned under (2) are the most common and characteristic. The Gryphea convexa of this bed is much smaller and thinner than that found in the first.

The bed of sand between the second and third beds of marl has nothing remarkable about it, except the grains of marl scattered through it. Its meeting with the top of the second bed is not known to have been found. It can be seen under the third bed in the pit of Elisha West, of Deal, that of Rulief Vandeveer, of Poplar, that of Thomas Longstreet of Squankum, and it is said under that of John Shafto, of Shark River. The bed itself has been opened near Elisha West's in Deal, and the sand used as a fertilizer on account of the marl grains in it. It bears a striking resemblance to the beach sand of the neighborhood which has also been used for the same purpose. No opportunity has occurred for measuring the thickness of this bed, but from the inclination of the beds above and below, it may be estimated at not less than thirty feet.

The *third bed* of marl may be described as consisting of three layers, as follows:

1. Twenty feet of green marl. This contains a considerable percentage of greenish clay: it is distinguished as a quick and powerful fertilizer; the most noted marls of Squankum, Shark River, Poplar and Deal are from this layer.

2. Fifteen or twenty feet of a pale greenish clay or earth. No marl grains are found in this layer, though it is called marl and possesses active properties as a manure. It is flaky in its structure, and when exposed to the air fades to a light ash color.

3. From five to fifteen feet of the above clay, largely mixed with marl grains.

The last named layer is opened to the greatest thickness in the pits of Jacob White, Peter Drummond and Amos White, in Deal; in that of O. F. Pettit, Shark River, and in that of J. S. Forman, near Lower Squankum, it is not so thick. In all these it can be seen running into the layer next below.

There are no localities where all these layers can be seen in a single place, but they can be seen in succession in numbers of places, as in the pits of Elisha West, G. Hendrickson and Thomas Borden, of Deal; in those of J. Shafto, H. Hurley, G. Shafto and J. L. Tilton, of Shark River, and in those of T. Longstreet, T. Weeks and J. S. Forman, of Squankum.

Fossils are not very abundant in this bed. A few casts, and still more rarely shells, have been found in the lower layer; it is not known that any have been found in the middle layer; in the upper, casts and impressions of shells are found. They have not been examined with sufficient care to determine the species; they are, however, entirely different from those of the two lower beds.

III. The sands which form a strip along the southern border of this county join the marls in a very irregular line, ridges of them extending almost to the middle of the county, while in the valleys of the streams, the marl comes to the surface several miles further south. They have not yet been examined with sufficient care to render it necessary to make any report upon them.

The interest felt in the marl stratum by a very large portion of the inhabitants of Monmouth, has induced me to devote most of the time, thus far, to ascertaining and systematizing facts relating to it. The examinations of the clay stratum and of the sands promise to be of much practical utility, though the soils where they occur have not yet been brought to the high state of cultivation of the marl region, and they are generally thought of less value.

The regular order of occurrence of the different beds of marl in the district surveyed led to a desire to examine their relative position in the south-western part of the State. For this purpose the stratum was crossed from Allentown to New Egypt, and again in the vicinity of Salem, the same order of succession of beds was found.

The marl pits of N. Woodward, at Cream Ridge, belong to the first bed. The ridge itself is part of the ferruginous sand bed. The pits at Hornerstown, and those of Mr. Imlay and Mr. Horner, near New Egypt, are in the second bed; so also are the gray marls, such as those in Governor Fort's pit. The pits of Mr. Irons, south of New Egypt, and others from there on to Poke Hill, in Burlington County, belong to the lowest layer of the third bed. The upper layers have not been found in that vicinity.

The marls in Salem County, at Mannington Hill and at

Woodstown, belong to the second bed. At Batten's Mill, above Swedesboro', the first marl bed is seen. The ferruginous sand lies between the two. The third bed has not to my knowledge been found in Salem County. The marl at Mullica Hill belongs to the second bed. William H. Snowden, of that village showed me a collection of tertiary shells from a locality about two miles south or south-east from there, and among these were some casts of shells of the same species with those found in the lower layer of the third bed. I hear that he has since found the bed containing those characteristic fossils.

From the report of Professor J. C. Booth on the Geology of Delaware, it appears that at least two of these beds are found in that State. The stratum is known to extend into the States farther south.

The hasty examination given to the different beds west of Freehold, does not enable me to decide whether they retain the same thickness, or whether the first and third beds grow thinner towards the south-west. They are not as well exposed or as extensively worked; the greater portion of all that is used being taken from the second bed. Other causes than the thickness, however, affect the amount of their exposure. For example, the increased breadth of the marl stratum on the eastern side of the State is partly due to its northern border being on elevated ground, and its dip towards the south-east only a little more than the slope of the country in that direction; while on the western side of the State, the stratum is diminished in width from its northern border being on low groud and its dip to the south-east, contrary to the surface of the country, which rises in that direction. The several beds are much better exposed in a rolling country than in one that is even or flat; thus, in the district surveyed, the first bed, though thinner than either of the others, is by far more exposed than both of them together. The country in which it occurs is uneven and hilly; the marl may then be found either in the valleys or the side hills, and these are so common that almost every farm has a marl pit on it, and in some a pit is opened in every field. The country is much more even and level where the second and third beds are found, the valleys of the streams making almost the only inequalities of the surface, and it is in these principally that the marls are dug. The practice in this respect is so uniform that many persons suppose they are only to be found in the valleys of streams. A knowledge of the fact that the beds are to be found on high as well as on low ground, that they continue nearly uniform in quality and thickness in straight lines across the State, and that they descend towards the south-east with a very regular slope, will, it is hoped, lead to a more general opening of pits in neighborhoods where marl is not now known to exist. Marls have been carted long distances, and deposited on lands which were underlaid by marl, and such, from my own observation, I am satisfied is still being

done in many places. In addition to the advantages to the farmer from having an abundant supply of marl close at hand, the value of good marl pits should be taken into the account. Pits ten feet square, and as deep as the purchaser chooses to dig them, are sold for from five to seven dollars. An acre contains forty-three thousand five hundred and sixty square feet, or more than four hundred and thirty-five such pits, worth, at the lowest price, two thousand one hundred and seventy-five dollars, and, at the higher price, three thousand and forty-five dollars. Such lands are worth searching for, and, if the work is judiciously done, they will be found. The following directions may aid in making examinations.*

Knowing that the general direction of the beds is a little west of south-west, a line traced in that direction from any pit already opened, will continue on the same bed. Or a line run between two pits of the same bed, will continue on the same throughout. Searches by digging down or by boring may be made any where on such lines; the lowest ground will usually have the least thickness of soil, or *top dirt.* If this dirt is found too thick for profitable working, other places may be tried, for the marl is worn or gullied in its upper surface sometimes, and the best points for opening may not be hit at the first trial. If the lines are run over uneven ground, allowance must be made for the dip or descent of the beds, which is towards the south-east, and at the rate of from twenty to fifty feet a mile. This dip will cause beds to appear further to the north-west if the ground is higher, and to the south-east if it is lower than that started from.

COMPOSITION OF THE MARL, AND THE CAUSE OF ITS FERTILIZING ACTION.

The value of this deposit as a manure, and the surprising influence it has upon the agriculture of a large district of country, have drawn the attention of scientific farmers and chemists to its composition.

Mr. Seybert, of Philadelphia, made a careful analysis of this marl, which was published in 1822, in the second edition of Cleaveland's Mineralogy. He found ten per cent. of potash in it.

James Peirce, Esq., examined the marl beds of New Jersey, and published an interesting account of them in Silliman's Journal, vol. vi., page 237, in 1823. He attributes the virtue of marl principally to its shells and other calcareous ingredients.

Dr. R. Harlan, in a paper containing remarks on the Geology

* Borings for marl can be easily made with a common auger; an inch and a half one is large enough. Its shank may be lengthened as much as is required by welding on a rod. The handle should be made to slide on this rod, and fasten with a set-screw or wedge. The auger needs raising every few inches to clear it, and to examine the material penetrated, some of which will be found sticking in the twist of the instrument. With such an auger, a hole from ten to twenty feet deep can be made in a few minutes.

of West Jersey, in volume iv., page 15, of the Transactions of the Academy of Natural Sciences of Philadelphia, in 1824, attributed its value in some cases to its fossil shells, in others to the iron pyrites in it, and in still others to the clay which it contained.

A paper on the same subject, volume vi., page 59, Transactions of the same Society, in 1828, by Professor Lardner Vanuxem, says, "the marl of New Jersey and Delaware appears to owe its fertilizing property to a small quantity of iron pyrites (which passes to sulphate of iron by exposure to the air), and also to animal matter, to its color, and to its effect when mixed with sand, of diminishing the calorific conducting power of the latter."

Prof. Rogers, in his Geological Report of New Jersey, considers that there is abundant evidence "to prove that the true fertilizing principle in marl is *not lime*, but *potash*."

Prof. J. F. W. Johnston, in his Notes on North America, made in 1850, volume ii., page 308, says, that on analyzing some of the green grains and sand, he found "from one to one and a half per cent. of phosphate of lime," and to this he attributes its fertilizing power.

In the Working Farmer for April 1, 1853, are several analyses of marl by Dr. Charles Enderlin, of New York. His specimens were from the pits of the North American Phalanx. He found two and a half per cent. of phosphate of lime in one specimen. He also found that the alkali was not all potash, but part soda. The fact of soda being a constituent of the marl was published in Silliman's Journal, second series, vol. ix., page 83, for 1850, from an analysis by William Fisher.

Numerous other references might be given, but the above are enough to show that the question is still an interesting one.

The following analyses show the principal constituents. Sulphates of iron, lime and alumina, phosphates of iron and lime, chloride of sodium, organic matter, &c., which can be detected in it in small quantities, will not materially affect the proportions of the above substances.

The first (1) is the analysis made by Mr. Seybert, the second (2) is the average given by Professor Rogers, and the third (3) is the analysis made by Mr. Fisher.

	(1)	(2)	(3)
Silex,	49·83	48·50	58·26
Alumina,	6·00	7·80	8·85
Protoxide of Iron,	21·58	22·80	24·15
Potash,	10·12	11·50	5·36
Soda,			1·60
Lime,		·50 or less	1·73
Magnesia,	1·83	trace	1·10
Water,	9·80	7·90	10·12
Loss,	·89		
	100·00	99·50	101·17

The preceding statements and analytical results show that the subject is by no means a plain one. To me it is one of deep interest, and I have taken every pains to inform myself upon the practical agriculture of the district, and the influence which marl has exerted in bringing it to its present high condition. With this knowledge my chemical examinations have been conducted, but they are not yet in such a state of forwardness as to be presented complete. A few approximate results will be given.

In the following table the amounts of phosphoric acid and lime are given, in the first and second columns. They are averages from several analyses of specimens from different pits. The third and fourth columns give the amount of phosphate and carbonate of lime. The phosphate is calculated from the phosphoric acid, and it probably exists in the marl in this form. The only doubt of it arises from the fact that phosphate of iron is a common mineral in this stratum. Careful examinations have not been made to determine the amounts of potash and soda; enough, however, has been done to show that they are always present, and constituting from five to ten per cent. of the whole.

Percentage of Phosphoric Acid, Lime, Phosphate of Lime, and Carbonate of Lime, in marls from the different layers.

BED.	LAYER.	Phos. Acid.	Lime.	Phos. Lime.	Carb. Lime.
1.	1. Sand marl,..........	0·76	1·00	1·55	0·37
	2. Black marl,.........	0·63	1·50	1·29	1·50
	3. Blue, or gray marl,...	1·14	8·50	2·33	13·04
	5. Top marl,...........	0·00	7·23	0·00	12·91
Fer. Sand,	Green clay,............	1·20	1·65	2·25	0·71
2.	1. Grain marl,.........	0·76	0·90	1·55	0·19
	2. Green marl and shells,		10·20		18·21
	3. Shells, yellow marl,..	0·00	27·44	0·00	49·00
3.	1. Green marl,.........	2·80	2·40	5·71	0·00
	2. White marl,.........	0·78	1·50	1·59	1·23
	3. Blue marl,..........	1·04	1·70	2·13	1·09
	Dry-Bank marl,.......	1·14	0·30		0·00
	" "	1·39	0·50		0·00

The results presented agree, generally, with the experience of farmers. The marl containing the largest amount of phosphate of lime is the first layer of the third bed; the green marl of Squankum, Deal, Shark River and Poplar. It is noted for quick and powerful action when applied in light dressings; from five to twenty loads on an acre produce good effects, and it is sometimes used in even smaller quantities. No. 3 of the first bed is

well known as an excellent marl. From one hundred to two hundred loads are commonly applied to an acre, and such dressings last fifteen or twenty years. It will be observed that this layer contains less phosphate, but much more carbonate of lime than the one just mentioned; and probably this is the cause of its more permanent action. The first layer of the second bed seems, from the analysis, to be much better than practice has found it. The difference may be owing to the coarseness and cleanness of its grains, for when mixed with quicklime and applied to the soil, it produces excellent effects. The dry-bank marls, it will be observed, are deficient in lime; phosphoric acid is found in them in the usual amount. These specimens were from the first bed, and probably the third layer. They have usually been thought equal to the wet-bank marls of the same bed for a short time, but to wear out sooner. Other comparisons will suggest themselves to the minds of inquiring farmers.

"POISON," OR "BURNING" MARLS.

Marls are found in all parts of the stratum, which are said to be *burning*, or *poison* in their properties; so much so as to destroy vegetation. In some cases, where they have been freely applied to the soil, they have destroyed its fertility for years. These marls are not confined to any particular layer, or bed, but are found in spots, or patches, in all of them. The dark clays above and below the first marl bed also possess the same properties, and being frequently mistaken for genuine marls, have done serious injury to crops upon which they have been applied. The same is true of the brownish clay, called *rotten stone*, which is found on top of any of the layers of the third bed. In all these cases the injurious effect is due to sulphate of iron (*copperas*), or to that substance mixed with sulphate of alumina (a kind of *alum*). The latter substance is not near as common as the former. Either of them can be easily distinguished by the taste; the copperas is well known by its astringent inky taste; the other, by the taste of alum. When marls or earths containing them are exposed to the air, yellowish white incrustations of these salts form on their surfaces. If other tests are desired, take some of the marl and boil it in two or three times its weight of water, in a clean earthen or porcelain dish; then strain the water clear from the marl. The copperas and alum will be in solution in the water. If some of this water is poured into strong tea, it will turn it black; if poured into lime water it turns it a dirty white; and if added to the blue liquid made by pouring hot water on leaves of red cabbage, the color is changed to a red. If aqua ammonia (*hartshorn*) is poured into it, there is a reddish or greenish sediment formed.

Professor Rogers, in his report, recommended that such marls

be exposed to the weather some time before using, that the copperas and alum might leach out. As a still better method, he recommended composting them with quicklime, using perhaps a bushel of lime to a hundred bushels of marl. Wherever this remedy has been tried it has been found effectual, and upon soils which have been injured by the application of such marls it has restored their fertility. It is not so generally practised as it ought to be, most farmers thinking it cheaper to get marl from beds not contaminated with these substances. The action of the lime upon the copperas produces *plaster*, but this is already in the marl, as is shown by its forming a white crust or powder on the surface of marls which are exposed to the open air, as well as by the sparkling little crystals of it which may be seen in many cases. Plaster is not generally found to produce any effect upon soils which are well marled. Still the use of lime with those marls cannot be too strongly recommended, the very fact that copperas and alum are present proving a want of lime, and whenever there is a sufficient amount of quicklime, or of carbonate of lime, in a marl, these substances cannot exist. The use of lime, too, may give activity to marls, which by themselves are almost valueless, causing the grains to crumble, and give up their fertilizing constituents to the growing crops.

Wells which are sunk in the marls frequently contain so much of the copperas and alum in their waters, as to be unfit for making tea or coffee, turning the tea black. A little saleratus or pearlash, or even woodashes, boiled in the teakettle with the water, corrects this.

Art. V.—SEBASTOPOL AND HARD ROCKS.—By Henry A. Hildreth, Geologist and Mining Engineer.

The siege of Sebastopol by the allied armies of France, England, Turkey and Sardinia, presents many considerations worthy of attention by the student in geology and mining engineering. The remarkable resistance offered by the Russians enclosed in this series of fortifications to the best-appointed siege train the world has ever seen, managed too by the most skilful engineering talent which those scientific countries, France and England, could produce,—has been written about, wondered about, and variously commented upon by the press—yet there is one view of this resistance which, either from design or otherwise, appears to have been totally overlooked—viz., the nature of the rocks upon which, and of which, the Russian works are built. Men educated in the Polytechnic schools of France and England, and

of our own West Point said, Gibraltar, San Juan d'Ulloa, and St. Jean d'Acre, have twice been taken by siege, as well as Rhodes, and the renowned Moro Castle of the Havana, and why do these Russian works offer such an unaccountable resistance? The answer, it appears to me, is, that fortifications built of the most tenacious rocks known to geologists, and adequately defended, have *never* been reduced by regular siege operations. Gibraltar, which is excavated in porphyry, that ranks with trap and basalt as to its hardness, has been twice captured, it is true, but in each instance by treachery. San Juan d'Ulloa is built of sandstone, and the Moro Castle and St. Jean d'Acre are, I am assured, built of limestone, both of which rocks are less resistant or more friable than basalt, trap and porphyry. A granite fort, bombarded by Lord Nelson's fleet, showed no signs of injury, although this rock is not esteemed as resistant as trap, basalt and porphyry. It therefore appears evident, that works constructed of the softer rocks, such as limestone and sandstone, have been battered down by cannon balls and shells, in several instances, while works constructed of either of the most resistant rocks have seldom, if ever, been demolished and reduced by such means.

The rock which forms the harbor of Sebastopol, and upon which the forts that defend it are built, is *basalt*, a rock quite as hard as trap. This fact appears evident from all the maps of Sebastopol, the bold columnar structure of the shores of the Black Sea, near this port, and the outline of the harbor itself. Streams of this igneous rock, in a molten condition, have flowed downward towards the centre of the harbor from either shore, and at the extreme point of either of such streams of basalt, the Russians have constructed their marine batteries; and it appears probable, also, that the works themselves have been built of this extremely hard rock. Hence it is evident that the reason why the Allies have not yet been able to effect an impression upon these works, with all their artillery, is simply a geological one, directly to be referred to this hard rock, which prevents successful mining operations, for the purpose of blowing up the walls of the forts, and causes the cannon balls to fall as harmless as hail upon them. I have been confirmed in this geological opinion, formed from an examination of correct maps of Sebastopol, by the fact that a specimen of this rock, which has recently been sent to my friend, Lieutenant W. D. Porter, of the U. S. Navy, by one of the French officers, is unquestionably basalt. But it is not alone the nature of this rock that has proved a powerful means of defence. The Russians, it must be confessed, have not been at all behind the Allies in their appliance of all the improvements in modern science. At Silistria, they learned from the Turks the effectual resistance offered by earth-works, erected in advance of, and covered by, the stone works, and applied them with remarkable success to resist an approach by parallels. Whether Colonel

Todtleben was the first to observe and apply this fact, or not, we have no direct information, but are led to infer the fact. The advantage of earth-works we have observed in our own country, in the defence of Fort Moultrie and Fort Brown.

To New York City must be given the credit of having first applied the hardest rocks to an economical purpose in this country. The well-known Russ pavement of Broadway, and other streets, owes its superior character to the fact that it is trap rock; and, it may be regarded as one of the most fortunate circumstances for this city, that from the high lands of the Nevisink to more than fifty miles up the Hudson, on its west bank, there occurs a stupendous trap dyke, full an eighth of a mile broad, as shown by the cut of the New Jersey Railroad, which will furnish for all coming time a desirable pavement for this great city and its suburbs, as well as for an article of export. It is vastly superior to granite for this purpose.

The cost of excavating, by mining operations, the various rocks in which the mineral lodes are found, consequent upon their degrees of hardness, may not be out of place in this connection. I take for a near approach to this cost, as it actually occurs, the estimates of an experienced Cornish mining Captain, accustomed to contract for such work. These estimates, it should be observed, are made sufficiently "large" to cover the actual expense of labor in excavating, tools, sharpening tools, powder, charcoal, candles, superintendence, and in fact all cost, except dressing the ore raised, and also including liberation of water to the depth of 200 feet. This expense is for *sinking* shafts and for *driving* levels. The cost of driving is the smallest sum named, and that of sinking the largest sum named. The estimate is for one fathom of six feet, viz.,

Trap and basalt . .	from	$40	to	$50	per fathom.
Granite and porphyry .	from	20	to	25	"
Slate rock . . .	from	20	to	30	"
Magnesian limestone .	from	17	to	20	"
Sandstone . . .	from	15	to	20	"
Lime rock . . .	from	15	to	20	"
Decomposed mica slate .	from	8	to	9	"
Decomposed granite .	from	2	to	5	"

JOURNAL OF MINING LAWS AND REGULATIONS.

DIVERTING WATER FOR MINING PURPOSES.

In the two previous numbers of this Magazine we have given a report of the progress of a suit where the question of the right to drain mines was at issue, in consequence of the drying up of sundry springs as was alleged, because the

water was pumped out of a mine. The parties were C. M. Wheatley deft. Jacob Baugh plff. That case has been carried to the Supreme Court of Pennsylvania, and a decision has not yet been rendered.

We now report a case for diverting water from a stream for mining purposes. The suit was brought by John Chrisman against C. M. Wheatley. The case has been carried to the Supreme Court of Pennsylvania, and the decision has been rendered. We give the history of the case, the points of the parties and decision of the Supreme Court.

The Case of John Chrisman v. Charles M. Wheatley.

Abstract of Proceedings.

Dec. 3, 1853, summons issued. Same day narr. filed and rule of reference entered. Dec. 19, 1853, arbitrators chosen. Jan. 27, 1854, arbitrators report for plaintiff $174 damages. Feb. 15, 1854, Deft. appeals. Feb. 28, 1854, rule to plead. March 7, 1854, Deft. pleads not guilty.

Jan. 3, 1855, jury empanelled.

Verdict and Judgment.

Jan. 8, 1855, verdict for plaintiff, $341 damages, and six cents costs. Jan. 9, 1855, verdict fee paid, and judgment *nisi* on verdict.

History of the Case.

The defendant is the manager of the operations of the Brookdale Mining Company, whose works are near Phœnixville, in Chester County, Pennsylvania, on land leased of Joseph Funk. He also manages the works of the Wheatley Mining Company, in the immediate vicinity. The plaintiff owns a farm adjoining the property of the Brookdale Mining Company, the greater part of which he occupied and used for agricultural purposes. The remainder he rented to the Chester County Mining Company. A small stream of water passes through the property of the Brookdale Mining Company, near their shaft and washing floor; enters the farm of the plaintiff at the dividing line of the two farms, and empties into the Pickering Creek, below the works of the Chester County Mining Company. Prior to 1791, the two farms were owned by Llewellyn Davis. On the 21st of February, of that year, Llewellyn Davis conveyed to his son, Joshua Davis, the farm now belonging to John Chrisman, the plaintiff, containing 96 acres and 86 perches, together also with the privilege of digging and keeping in repair a dam and artificial water-course, leading from the said stream, on the upper tract, now belonging to Joseph Funk, and through a part of said tract into the farm of the plaintiff. The water-course is stated in the deed, as being for the purpose of watering the meadows of the said Joshua Davis, his heirs, and assigns, for six days, out of every seven, when needed for that purpose, and at all other times, when not so needed, the water is reserved for the use of the other tract. This water-course leads along a meadow-bank, and passes through the plaintiff's barn-yard, where he has been accustomed to use it to water his horses and cattle, to another meadow. The two meadows, the one above and the other below the barn, have been watered by the water flowing along the water-course.

The Brookdale Mining Company commenced operations in October, 1852. A vein of lead having been discovered near the natural channel of the above stream, at the point where the artificial water-course branched off, a new channel was dug for the water, with a current sufficiently wide to keep it clear of the intended shaft, and a shaft was sunk close upon the border of the stream, as it had previously run. After the shaft had been sunk to some depth, and the subterranean water began to interfere with the mining opera-

tions, a steam engine was erected for the purpose of working the pumps by which the water was to be pumped from the mines. The boiler of this engine was supplied with water either from the stream already mentioned, or from a small tributary, which united with it just above the engine house. The engine began to work in March, 1858, and continued to work, with but little intermission, till after the commencement of this suit. The water pumped up from the mine was for a time thrown into the natural channel of the stream, and pursued it till it came to the point of junction with the ditch already mentioned, where it divided, part passing on by the natural channel into the Pickering, and part by the ditch along the meadow-bank, through the barn-yard, and to the meadow beyond. The volume of the stream was considerably increased by the access of this underground water, but of that increase no complaint was made. But it was necessarily more or less turbid, and some dissatisfaction seems to have been expressed by the plaintiff on that account, and a rumor of it came to Mr. Wheatley. In order to remove all cause of complaint, the defendant, about the latter part of the summer or the beginning of the autumn of 1858, directed launders to be constructed, by which all the underground water should be conveyed from the Brookdale works in another direction, and carried to the Wheatley works, whence it would flow into the Pickering, without touching the plaintiff's property. Soon after the launders were erected and the underground water, which had been previously poured into the channel of the natural stream began to take a different direction, the plaintiff, by written notice, complained to the defendant of the diversion of his water, and required it to be restored to its natural channel. No attention having been paid to this notice, it being evidently predicated on a mistake, it was followed within a few days by a second of like import, and very soon after by a writ. A declaration was filed the day the writ issued, complaining that the defendant had sunk a drift or shaft for mining purposes, erected a steam-engine and pump upon the banks and sides of the stream, above the plaintiff's premises, and by means thereof, diverted the waters of the stream, and also threw into the same divers quantities of mineral ore, filth and refuse, by which the water of the stream was corrupted.

On the trial of the cause the plaintiff exhibited without objection the deed of Llewellyn Davis already mentioned, by which his right to dig a ditch leading from the stream on land now of Joseph Funk, under whom the defendant holds, into his own land, for the purpose of watering his meadows, was secured. He also showed that during the summer and autumn of 1858, the waters of the stream and ditch on the land of the plaintiff were lower than usual, and he produced two witnesses who said that the failure of the water in the stream and ditch, was caused by its being turned into the launders, by which it was carried to the Wheatley works; but this was denied by others on the same side. In addition to this he gave some testimony to the effect that the water was at times a good deal muddy in the ditch of Chrisman, owing to the mining operations above, so as to be unfit for his horses to drink.

The defendant on the other hand proved, by a large number of witnesses, that there was no connection whatever between the launders which carried the water pumped from the mine to the Wheatley works, and the stream above; and that by no possibility could there be any diversion in that direction, and also, that all the diversion that actually occurred, was of the quantity actually consumed or turned into steam in the boiler of the engine by which the pumps were driven. He also proved that the water which came from the mine was not usually unfit for the use of cattle and horses.

After the defendant had closed his case, the plaintiff opened his rebutting testimony, and offered to prove that the plaintiff had used and enjoyed the water that flowed in the ditch from the Funk (formerly Davis) property for watering his cattle in the fields and barn-yard, for upwards of twenty-one years.

To this the defendant objected, but the court overruled the objection and sealed the first bill of exceptions. Evidence was then given of the plaintiff

having used the water of the ditch for twenty-five years, for watering his cattle.

The question on this bill is, whether the plaintiff, having exhibited his deed, duly recorded, by which his right to take water from the stream by a ditch leading therefrom through the land of an adjacent proprietor was established, and by which also his right to the use of the water was limited to the purposes of irrigation, and having rested his case on that deed, without denial on the part of the defendant, of the right acquired thereby, was entitled to give evidence of a use of the water of the ditch, not contemplated or allowed by the deed, and to recover damages for the deprivation of that use.

The second bill of exceptions depends upon the same principles as the first.

The plaintiff having shown that the water of the ditch flowed through and watered meadow-ground on each side of the barn-yard, asked the witness to state whether during the last summer the water in the barn-yard was muddy, for the purpose of showing its unfitness for the use of the plaintiff's cattle. The defendant insisted that the condition of the water in the barn-yard for the use of the cattle was of no importance, and objected to the evidence. It was to the overruling of that objection that the second exception was taken.

The defendant asked the court to instruct the jury, that the defendant was entitled to a reasonable use of the water, for the purpose of his business, and if the jury believed that no more than a *reasonable* quantity for such purposes was used, as for the creation of steam to drive his engine, the plaintiff had no cause of complaint on that ground. This point the court declined to affirm, and in this, it is conceived, they fell into error.

The defendant also requested of the court to instruct the jury that the plaintiff's right to the water conveyed by the ditch, being set forth in the deed under which he claimed, was not to be extended to purposes which the deed did not contemplate; and that the plaintiff was not entitled to claim damages for any injury which might have resulted from the water of the ditch being rendered unfit for the use of cattle at his barn-yard, as no such use was indicated in the deed. The court, admitting the correctness of the legal principle involved in the defendant's points, denied its application, and deprived the defendant of the benefit of it before the jury. Here also, it is believed, there was error.

Plaintiff's points.

1. The proprietor of lands on the banks of a stream cannot divert or diminish the quantity of water which would otherwise descend to the proprietor below.

2. In judging of the proper use of water, the size and capacity of the stream rightly enter into the inquiry.

3. Whenever so much of the volume of water is obstructed as to be plainly perceptible in its practical use below—whenever the channel exhibits a loss or diminution of the accustomed fluid, an injury is committed, for which an action may be sustained, and this, though it may not have been actually used by the lower proprietor.

4. The right to have a stream running in its natural course is *ex jure naturæ*, and *an incident* of property, as much as the right to have the soil itself in its natural state, unaltered by the acts of a neighboring proprietor.

5. If the jury believe that the defendant, by sinking the shaft of the Brookdale Mine, or by his other mining operations there, dried up springs which contributed to the volume of the stream in question, or sensibly diminished the water of the stream, the plaintiff is entitled to a verdict.

6. The erection of any thing on the upper part of a stream of water, which poisons, corrupts, pollutes, or renders it offensive or unwholesome, is actionable.

7. The plaintiff is entitled to the use of the waters of the stream in question

in their natural state, for the purposes of his farm, and the defendant had no right to corrupt the water by discharging muddy or impure water into the stream from the pump or shaft of the Brookdale Mine, or from any other source.

8. If the jury believe that the waters of the stream, passing through the farm of the plaintiff, have been sensibly diminished in quantity, or corrupted, or rendered impure by the action of the defendant or his operations, the plaintiff is entitled to be compensated in damages to the full extent of the injury he has suffered.

Defendant's points.

1. Every owner of land on the banks of a stream of water is entitled to the use of the water on his land for agricultural or manufacturing purposes, provided he return it to its channel before leaving his land without material and unreasonable diminution.

2. The defendant was entitled to the reasonable use of the water for the purposes of his business, and if the jury believe that not more than a reasonable quantity was used for such purposes, as for the creation of steam to drive his engine, the plaintiff has no cause of complaint on that ground.

3. The plaintiff's right to use the water conveyed by a ditch from a point above the line of the Funk property, being granted to Llewellyn Davis, the person under whom he claims, by deed, the rightful enjoyment of it is limited by the terms of that deed, and is not to be extended to purposes which the deed does not contemplate.

4. The plaintiff is not entitled to claim damages for any injury which may have resulted to him by reason of his inability to obtain a supply of water for his cattle or horses, from the ditch by which water is obtained from the Funk property, under the stipulations contained in said deed, to whatever cause that inability may be owing.

5. If the jury believes that the dirty water coming from the dressing-floor of the Brookdale Mine was turned into the ditch that led to the plaintiff's barn at his instance or by his permission, the plaintiff is not entitled to recover damages on account of the impurity of the water so turned into said ditch.

6. The plaintiff is not entitled to recover in this action for any alleged injury arising from the drying up of the springs, which contributed to the volume of the stream in question, even if the jury believe that the defendant by digging his shaft cut off the subterranean stream by which those streams were supplied.

7. There is no evidence of any subterranean stream, supplying springs which fed the stream in question, being cut off in sinking said shaft.

Charge of the Court.

We omit the charge of the judge in the lower court, and the exceptions which related chiefly to the evidence admitted, and annex the opinion of the Supreme Court.

Supreme Court in Banc.—Harrisburg, May, 1855.—Wheatley vs. Chrisman. Error to Chester county.

"Where a stream of water runs through the land of different owners, the upper proprietor, or he whose land the stream first enters, has a right to such use of the water as he can make without materially diminishing it in quantity, or corrupting it in quality; and to no other or greater use.

"In an action for a violation of a legal right, evidence that the plaintiff is injured in a particular use of that right for a purpose important to himself, and which use he was entitled to make, is admissible to swell the damages.

"One to whom an easement has been granted by deed for a special purpose, may by adverse use of it for twenty-one years, for other and different purposes, claim a right by prescription to the whole extent of such different uses.

"Where an easement cannot be used for the purposes specified in the deed, without rendering it liable to be innocently and rightfully used for other and different purposes, the express grant of the former privilege implies a grant to the latter."

The opinion of the Court was delivered by Black, J.

There was no trouble in the court below, and there can be none here, about determining what are the main and principal rights of the parties, in regard to the subject matter of the controversy. A small stream of water runs through the land of both. The defendant is the upper and the plaintiff the lower proprietor. It is asserted that the defendant, who is working a lead mine, has corrupted the water, and sensibly diminished the volume of the stream. If either of these allegations be true, the plaintiff has a right to recover in this action; and, if one verdict be not enough to make the defendant discontinue the nuisance, a second jury will be instructed to give such damages as will cause him to wish that he had taken the warning of the first. The wrong must cease, no matter how trifling it may seem. The right of the plaintiff is absolute to be restored to the full enjoyment of his own property, and is not dependent in any manner upon its value to himself or his adversary.

We are quite content with the exposition which the Judge of the Common Pleas gave of the law which governs the owners of lands through which a stream of water passes. His definition of the rights and obligation is accurate as well as clear. There is indeed no complaint of any thing he said on this branch of the case, except his refusal to affirm, without qualification, one of the defendant's points, and if there be a part of the charge better entitled to our approbation than any other, it is the answer to that point. The proposition of the defendant was that he had a legal right to use a *reasonable* quantity of the water for the purpose of his business. The Court replied that his business might reasonably require more than he could take consistently with the rights of the plaintiff. We cannot see how, or on what principle, the correctness of this can be impugned. The necessities of one man's business cannot be the standard of another's right, in a thing which belongs to both. The true rule was given to the jury. The defendant had a right to such use as he could make of the water, without materially diminishing it in quantity, or corrupting it in quality. If he needed more, he was bound to buy it. However laudable his enterprise may be, he cannot carry it on at the expense of his neighbor. One who desires to work a lead mine, may require land and money as well as water, but he cannot have either unless he first makes it his own.

For upwards of twenty-five years, the plaintiff and those under whom he claims, have maintained a dam across the stream, above his own line, and on the land occupied by the defendant. By means of this dam, a portion of the water is diverted into a ditch, and is led along a higher part of the plaintiff's farm than that through which it flows in its natural channel. It is thus carried to the plaintiff's barn yard, whence it is suffered to return again to the channel. Ever since the erection of the dam, the owners of the plaintiff's farm have used the water running in and from the ditch for the watering of cattle, as well as for the irrigation of the meadows. Evidence was offered and admitted, to show that the water was rendered so impure by the defendant's works, that it was unfit for beasts to drink. This was introduced solely to swell the damages, for the plaintiff could sustain his action, and compel an abatement of the nuisance, without any reference to the dam or the ditch, or the use he made or might make of the water so diverted, provided it be true that the water in the natural channel was corrupted or diminished, and if it was not so corrupted or diminished, he could not recover at all. But the fact that the plaintiff was using and had a right to use it in this particular way for a purpose important to himself, does entitle him to larger damages than he would be able to get by merely proving that his legal right, as a proprietor, had been violated without causing him any special loss or injury. The admission of this evidence, therefore, must have had some influence on the verdict, though its exclusion could not have defeated the action.

Every one will admit that a person through whose land a stream runs, may conduct it by an artificial channel to any part of his farm where he thinks it will be best for him to have it. He may use the part so diverted for the same purposes and to the same extent that he could use it if it flowed there through a natural channel, and may recover the same damages for any loss occasioned by the interference of another with his use of it; neither is it contended that the fact of the dam by which the water is diverted being in this case above the plaintiff's line, and on land not his own, makes any difference, if the dam be a lawful structure which he has a right to maintain. The plaintiff's right to maintain this dam is not disputed, and if it were, his actual maintenance of it for upwards of twenty-one years would settle it at once. The evidence that he has during all that time turned the water out of its natural channel at a point above his own line, and by means of an artificial channel carried it to his buildings, and there used it for watering his cattle, does not make out a *prima facie* case for any damages he may have suffered in consequence of the water being so corrupted, that he could no longer use it in that way.

But there is another fact in the case which the defendant's counsel insist is totally destructive of the plaintiff's right to recover for this specific injury. It is this: the dam was originally built in pursuance of an express grant, by deed, from the upper proprietor to the owner of the lower farm. This deed gives the right to divert the water for the use and purpose of watering the meadows of the grantee. The argument is, that the plaintiff could rightfully make no use of the water other than what the deed mentions, namely, the irrigation of meadows, that a different use of it, no matter how long continued, could raise no presumption of any other right than that which the deed gives, and that, therefore, when the water was so corrupted that the plaintiff's stock could not drink it, he was disturbed, not in the enjoyment of a right, but in the perpetration of a wrong. If these propositions be sound, the judgment ought to be reversed. The principal stress of the argument before us, by the counsel of either side, was on the question whether a person to whom an easement like this has been granted by deed, for a specified purpose, may use it twenty-one years for a different purpose, and then claim a right by prescription to the whole extent of his user. It does not appear that the point has ever been decided. We must ascertain the true rule as well as we can by the analogies of the law, and by a reference to original principles.

One who is in possession of land is deemed to be there by virtue of his title, if he has one. Upon this principle, a tenant for years, or for life, or for any other particular estate, cannot claim the fee or hold the land under the statute of limitations, after twenty-one years. Neither can a trustee or mortgagee, in possession, be permitted to set up an absolute title in himself. The quantum of interest, the duration or character of the estate which a person has in lands or tenement, over which he is exercising actual dominion, must always be ascertained from the deed, record or contract, if there be any, under which he has a right to hold it. Of lands which are unimproved, the constructive possession will also be confined to that part which is covered by the title. But where a man has a good title for one acre, and he goes into actual possession of that and also of another acre adjoining, there is no rule of law which forbids him to hold both after a lapse of twenty-one years. The last case, we think, is most analogous to the matter before us. When an easement is granted for one purpose, and the grantee exercises the right in the deed, and another right also, he is not less secure against all interruptions than he would have been if no express grant at all had been shown. It is as easy to presume another grant for watering horses, superadded to that for watering meadows, as it would have been in the absence of any deed, to presume that there was a grant for both together. If one man has a right of way over another's field, which he has exercised without interruption for twenty-one years, it will scarcely be contended that his right should be destroyed, by showing that he had a deed for a similar right of way over a different field. It is almost equally

clear, that if I grant a right to pass over my land on foot, and the grantee, instead of confining himself to that mode of passage, goes over it continually for twenty-one years, with wagons and horses, a grant for the latter purpose ought to be presumed, in addition to that of the foot way.

It is contended, that because the proprietor of the land above could not prevent the watering of cattle at the ditch; because it was not injurious to him; because he could not sue for such a use of the water, no presumption against him can arise from his omission to stop it. This argument proves too much. If it be true, it shows that the right to water stock out of the ditch was inseparable from the right to have the ditch there for the other purpose. Perhaps this is the best solution of the whole difficulty, and the truest view that can be taken of the subject. If the water cannot be used for irrigation without rendering it liable to be innocently and rightfully used for watering cattle also, then the express grant of the former privilege implies a grant of the latter.

We are quite clear that the plaintiff had a right to the water of the stream in its natural condition, the part that flowed into the ditch no less than the other; that the pollution or material diminution of it was a wrong, and that the Court or jury were right in giving damages for every injury, which was the direct, immediate and necessary consequence of that wrong.

The claim of the plaintiff being only for compensatory damage, and not being founded on the *animus*, but on the acts of the other party, it can be a matter of no consequence whether or not the defendant knew the extent of the injury he was committing. Judgment affirmed.

COMMERCIAL ASPECT OF THE MINING INTEREST.

New York, *August*, 1855.

Though mining is being steadily pursued with prospects of success, both as regards coal, gold, and copper products, yet the speculative disposition which marked the course of the Mining Stock market two years ago is now wanting. Every thing however is of the healthiest character. Coal Stocks attract the greatest attention, and there are more new companies forming for the mining of coal than of any other mineral. The mining of coal will be greater this year than in any preceding one. The old Reading Company has brought down, already, this season, unusually large supplies, reaching for the season 1, 470,324 tons. Their receipts and the large conversion of bonded debt into Stock, namely, two millions, has given increased confidence in the value of the Stock, which has advanced to 98½, after paying the recent dividend. Cumberland Coal Stock maintains a steady position. The receipts of this Company have been retarded by a large break in the canal; but the product is nevertheless large. There is a probability of the company diminishing its nominal capital by reducing the par value of its shares to about the present market price, that is, from 100 to about 80.

The large number of shares, 50,000, comprising the Stock of the Cumberland Coal Company, makes it a very speculative Stock. Of so large a number a considerable proportion must always be floating on the market.

The Coal River and Kanawha Cannel Coal Company have had a portion of its coal analyzed, and the result is as follows:—

Crude product from one ton by weight, 75 gallons, which on purification yielded

25 gallons	of Oil for lamps, not explosive.	
8 ditto	do.	ditto & for lubricating not explosive.
7 ditto	Volatile hydro-carbon explosive.	
10 ditto	Tar.	
12 ditto	Ammoniacal liquor.	
13 ditto	loss by waste and impurities.	
75		

The tar is manufactured into Concrete, and will yield 500 lbs. of Concrete per ton.

The product of the Cliff Copper Mine (Boston and Pittsburg) for May, June and July, 1855, was as follows:—

May	236,118 lbs.
June	264,870 "
July	286,384 "
Total	787,372 "

or 393½ tons of rough metal. Of this whole product, 366,448 lbs. were in masses, 210,431 lbs. in barrel work, and 210,493 lbs. in stampings. The average of the whole in pure metal is not less than 60 per cent., or 236 tons, worth in market, after payment of freight and smelting charges, not less than $118,000.

The market for copper is constantly widening and increasing, and those Copper companies who produce copper in sufficient quantity can be made to pay. Some of the Companies however long before the public, still call for assessments. The old Norwich Copper Company have made one of a dollar per share, payable 1st September on the Stock of that Company.

On the favorable side we have to announce that the old Pittsburg and Boston (Cliff Mine) Copper Company has just declared another dividend of eight dollars per share, payable on the 22d August, at the transfer office, Boston.

The Lake Superior Copper Mines, are the only mines at present productive on a large scale, though the Tennessee mines teem with copper ore: but the Companies working them seem to want funds.

We understand the negotiation for selling many of the Polk County mines to English capitalists, has been renewed with greater prospects of success. The "Limited Partnership Law" which has just passed the English parliament, has induced a freer disposition in taking hold of joint transactions by Companies in that country.

Mr. Stanley, who represents and controls the Eureka Mines of Polk County, as well as one other mine, has gone to London to join Mr. Gilbert, who represents the Isabella Company in carrying out those negotiations; the success of which will bring into active operation a large English capital. We learn that the Eureka Company is building smelting works on its property; and the Hiwassee Company have resolved to do the same. The copper produced from these mines is sent to England, where it finds a profitable market.

The Minnesota and Cliff mines of Lake Superior, both yield increased quantities this season. The Minnesota it is estimated will yield 1400 tons of crude copper, and the Cliff 1000, while last year the respective yield of those two mines was 800 and 1200. The Isle Royale is doing well. The whole of the production from all the Lake Superior mines this year is calculated at 3000 tons pure copper.

Notwithstanding this last product there is no speculative feeling in the Stocks. Many mines have been suspended. The mining district is being explored and surveyed with great minuteness by enterprising capitalists. The beds of copper are found to be of vast extent.

The North Carolina Mining Company is about, we learn, to be revived, the particulars of which we will give in our next number. We learn also that the Morris Copper and the Wheatley mines of Pennsylvania are resuming work.

The influence of the great abundance of money has hardly reached the mining market, on account of the slow growth of general confidence in mining adventure. This field of industry, however, presents great prospects to those who know how to use their capital with skill and energy. The mining wealth of the Southern and Western States is immense, and only in small part known; and so much of this wealth lies on the surface in contradistinction to the mines of the old world, that less labor is required to work them, but mining skill and experience seem to be wanting.

The prospects of the money market indicate continued ease, at low rates, so that the anxiety to use capital profitably cannot fail to reach in time the more sluggish mining interest.

The market moves in cycles. Extreme speculation and prosperity leads to over confidence, mistakes, losses, and individual ruin, though the country continues to prosper and to progress; and again these reverses lead to undue contraction, suspension of enterprise, economy, parsimony, which react again towards individual prosperity, renewed enterprise, spare funds, and re-excitement of undue speculation. We have passed through one of the depressive terms, and are just now beginning to move upward in a buoyant and expanding course.

The harvest proves a rich one beyond all past compare. Not only cereals but the yield of the great staple of cotton will be large. The hog stock will be large, because the corn crop is large and this great plenty of food and the material of clothing, will form the base of a coming prosperity which will distance all past experience in this country. With plenty of food and raiment we have to an unusual extent spare capital, the effect of a recent contraction in business, and of the large and continued produce of the gold mines of California.

These mines are not worked by Companies, but by individuals, on the sides of streams which wash down the gold over the auriferous strata, or who hew quartz rocks rich in gold. The latest advices speak of undiminished, and in fact, infinite resources, so that our "material" prospects are of the brightest kind.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

The yield of gold in California is more abundant than at any previous period. It is not easy to determine the exact amount. Beside the public shipments large quantities are held in private hands, of which no mention is ever made. Old fields are worked again and new discoveries are constantly made. Quartz mining is also becoming more prominent as a branch of industry. A general survey of the various mining districts, we hope to present, in a short time, as a permanent feature of these pages. In the present instance we content ourselves with a notice of only a few localities.

New and Important Ditch Enterprise.—The miners along the divide, below Snow Point, have commenced the construction of a new and extensive Ditch, which is to take the waters from the Middle Yuba, about fifteen miles above that place, and convey the same along the divide, supplying all the extensive diggings in that neighborhood, as far down as French Corral. The miners in that vicinity have not heretofore been able to work more than four months in the year from want of water. The proposed ditch will afford an abundant supply the year round. The plan of the company is novel, and of a character calculated to afford the greatest possible benefit to the community. The stock is owned almost exclusively by miners, and any one who chooses can go forward and work out his subscription for stock, provided he do so within the time contemplated for the completion of the work, which is fixed at the first of January next. The work was commenced about two weeks since, and upwards of fifty men are already engaged upon it. Laborers, who are becoming stock subscribers, are coming in as fast as the old supplies of water give out. The Ditch when completed, will probably be some forty miles in length, exclusive of branches. Sacket's saw-mill at Bloody Run, has been removed to a point near the head of operations, for the purpose of getting out the lumber required for farming. The completion of this work will be of vast benefit to this section of the country, and will more than quadruple the yield of the mines there within the first year.

Humbug Canyon.—This mining locality, situated on the north side of the South Yuba, about 12 miles above Neveda, is fast proving itself a misnomer. This place was worked as early as '49, but with so little success, that it has acquired the above *sobriquet*. Now, however, its prospects have changed, and it is yielding largely. Two companies of four men each, have been taking out upwards of $20 per day to the hand, for some weeks past. A company of five Germans, a short time since, took out about $800 in one week. There are now some two or three hundred men at work in this canyon, and nearly all doing well.

Iowa Hill.—A correspondent of the San Francisco Chronicle, gives a glowing, yet truthful account of Mining at Iowa Hill, from which we learn that the prospects of that flourishing town are equal, if not superior to any other locality in the State. It is estimated that nearly two millions of dollars have been expended in the development of the mining resources of that place. This immense amount of money has been drawn from nearly every part of the State. Among the heaviest contributors may be set down Grass Valley at not far from $150,000. This amount is still increasing by weekly assessments, as yet without one dollar having been returned. The immediate effect has been to make money scarce in Grass Valley, and thus to retard its prosperity. We venture the opinion, that had one half the money which has been sent to Iowa Hill, been expended in the development of our own resources, we should not now hear so many complain of hard times.

Kern River.—The editor of the Stockton *Argus* has been shown some specimens of gold and quartz rock from Kern River mines, by Mr. Heston, who runs an express to that region, connecting here with the Pacific Express Co. The gold from that country is in small, thin scales, and very minute particles, of less value than the gold of other mining localities, being worth $14 per oz. The gold quartz, however, looks more promising. The quartz is very rotten, and easily broken up, and particles of gold can be seen embedded in the surface exposed. It was taken from a claim on Kern River, which is yielding $12 per day to the hand.

By the use of the modern improvements of quartz crushing machines, the Kern River miners are confident of making their quartz claims pay them large wages.

The gulches are not worked at present, for want of water, and the river claims are not paying heavy enough to induce a great number of miners to remain, although a few claims are paying very well.

The Kern River miners base their hopes upon quartz mining, which they intend to go into extensively, as soon as they can procure the necessary machinery.

The quartz shown us, is valued to yield $2 to the pound, which we should consider to be not too high a valuation, judging from the quantity of gold apparent to the eye. We cannot be sanguine enough to believe, however, that Kern River abounds with such specimens as shown us.

Mining in Carson's Valley.—The mining in the valley has heretofore been mostly confined to a gulch some eight miles in length, and called Gold Canyon, which has its outlet in Carson River. About 400 men have been engaged in the mines, which are situated 14 miles from the principal settlement. The gold taken from these diggings is of a very poor quality, being worth but $13 to the ounce. It is heavily alloyed with silver. A prospecting party reported that the mines there were worked in a very inefficient manner—the old workers being mostly inexperienced men, just from the States. They feel confident of their ability to make the diggings pay with a proper application of industry and experience.—*Grass Valley Telegraph.*

Placerville.—The population of Placerville is estimated at about twenty-five hundred, including a goodly proportion of females. Prominent among the elements of moral progress may be named four churches, and the entire absence of public gambling houses. Under the new law they all quietly closed up. The effect upon public morals has been in a high degree favorable. The mining in this region is vastly more important than is generally supposed. It is even followed successfully by miners in the old bed of Hangtown creek, which has been worked over at least a half dozen times. But the main mining is confined to hill or tunnel diggings. They are opened into the hills on all sides, and have generally proved successful. One has been run through the hill which divides this place from Coon Hollow, so that a man may walk from one town to the other through the hill, instead of over it. The distance is about one thousand feet. It is estimated by a man who has surveyed most of them, that there are some 130 tunnels now being worked within two miles of Placerville.

Tunnels have been run into the divide between Webber Creek and the South Fork of the American River, for a distance of twelve miles, towards the Sierra Nevada, and the pay gravel has been struck every mile of the distance, on each side of the divide. It requires from 250 to 5,000 feet of rock tunneling before striking the pay dirt. It pays from fifty cents to four dollars a pan. It is estimated by those familiar with the subject, that between seven and eight hundred tunnels have been run in, or are being run in, to this divide, from a point nearly opposite this to one a little over twelve miles east, and on a line towards the Sierra Nevada. The divide from side to side is on an average nearly a mile wide. The gold it contains must be immense. It will require centuries to exhaust it.

The South Fork Canal furnishes a full supply of water for mining purposes

for this region and Coon Hollow. The Iowa Ditch furnishes the tunnels on the divide, as it takes water from the South Branch of the South Fork of the American, and runs for miles on or near its summit. In one of the tunnels a tree was found embedded in the solid rock, one-half of it decayed wood, the other like crystallized quartz, eighty feet from the mouth of the tunnel, and one hundred, by estimate, from the surface of the ground.—*Sacramento Union.*

ROCKY BAR MINING COMPANY.

This Company have issued the following statement, dated August 1st, instant:—

Owing to the breakage mentioned in last report (18th June), the works had to be stopped for over five weeks, causing by the delay, and for repairs, an expenditure of about $3,000, which had not been foreseen. By last advices the engine-shaft had been again cleared of water, and men were about to be put on to carry the drift to the vein. The vein itself had been struck in an air-shaft, 78 feet 9 inches deep, at some distance from the engine-shaft, and opened up 46 feet by drifts. The Agent describes it as being twice as thick as he expected, and rich in gold; generally considered worth $30 a ton. It will be remembered that $20 would pay well. He had 15 tons at the surface, and when 40 tons were got up, he would have them crushed.

Owing to the delays mentioned, and other causes of expense, the Agent was again short of money. By last advices his liabilities reached $5,600 more than his cash on hand; and as, until the mine is well opened up, he can take out daily only a small quantity of rock, his earnings will, for some months, be less than his expenses; and thus his debt will increase. Allowing the Agent to run in debt is against the principle the Company have always acted on; besides, the Agent strongly urges the danger of this plan; the richer the vein proves, the more urgent creditors will be, and the more the property is endangered.

It will be seen that the duty of the Directors compels them to call on the proprietors to protect their property, by furnishing means to pay off, not only present liabilities, but all that may be incurred, until the mine yields a weekly profit. Four per cent. is the lowest call that can be relied on to do all this.

This can now be called for with confidence, as the matter is no longer an experiment; the vein is ascertained to be there, and to be rich enough to pay for twice the outlay made. In the significant words of the Agent—"*Delay, or false economy, will be a suicidal policy; the Company have now their fortune in their own hands.*"

The English and California unpaid shares have been bought at auction for the Company, except 990 shares, bought by a party in San Francisco. The present issue is only 87,242 shares—the Company owning 112,758 shares. Out of these there shall be divided, to those who pay to the day, one share, free, for every one share paid on.

Payment to the day must, without any exception whatsoever, be rigidly adhered to, in this appropriation of the Forfeited Stock.

The Board have determined that this is the last assessment they will call.

P.S.—By advices from the mines to 14th July, the following intelligence has been received:

Thirty tons of quartz taken from the air-shaft have paid $25 per ton. One-third of this was dirt, which the Agent had not time to separate, being in haste to announce a result; owing to which, and the quartz being roughly treated at the mill it was sent to, he considers it to be rock which, if crushed in a mill belonging to the Company, would give $35 dollars per ton.

The ledge has been also struck in the drift from engine-shaft, and quartz taken therefrom has paid $40 per ton. Any thing over $16 is profit.

Stock has been purchased by miners in the Company's employment at $1 per share.

THE GOLD DISTRICTS OF THE EASTERN HEMISPHERE.

In an extensive notice of various gold districts of the world, by Prof. Ansted, we find a very clear statement of the gold region of Russia, and a summary of those in other parts of the Eastern Hemisphere excepting Australia. This interesting information we have condensed as follows:

Nearly all the gold of commerce previous to the discoveries in California and Australia, has been obtained from Asiatic Russia, Brazil, Transylvania, Africa, the East Indian islands, and Carolina in the United States; the whole annual supply being estimated, at about 80,000 pounds weight, and its value being about five millions sterling. This, however, must be regarded as an approximate value of the average of several years, as the supplies have for some time being increasing rapidly from the Russian mines.

The gold mines at present most productive are those of Russia, and chiefly Siberia. They extend first on the eastern flanks of the Ural, in a zone running north and south of the town of Ekaterinburg through five or six degrees of latitude; secondly, in the government of Tomsk and Yeneseik, where low ridges run northwards from the great chain of the Altai mountains, and where, over an area larger than the whole of France, not only are considerable quantities of gold found mingled with sand and gravel on the surface, but even the rocks themselves when pounded up are found to afford a per centage of that valuable metal.

Of the former of these districts, the mines of Berezovsk near Ekaterinburg have been the most productive, and yielded during the century previous to 1841, about 24,500 lbs. avoirdupois weight of gold (worth a million and a half sterling), obtained from something less than a million of tons of ore stuff. In general the matrix consists of coarse gravel, not unlike that found near Woolwich; but there are also true auriferous veins inclosed in a bank of rock, in which are many veins of quartz with gold disseminated. From these veins the valuable portions are extracted by vertical shafts and lateral galleries; and it is worthy of remark, that this is the only instance in the whole Russian territory where gold is extracted by the aid of subterranean workings.

Much more generally the gold is found in fragments of rock which cover the surface to a considerable thickness, and the metal is obtained by processes which will be described in a future chapter. Associated with the gold are other metals, as platinum and palladium, and diamonds have also been found, though rarely, both here, and at various points in the Ural chain.

The eastern district of gold-washings in Siberia includes in the whole three localities:—one between the valleys of the Obi and the Tom, the next between the Tom and the Yenesei, and the third, the most eastern, reaching from Yenesei to the Lena.

In each of these the metal is disseminated in a quartzy sand, or rather gravel rich in oxide of iron; but it seems to follow a particular mineral, since it occurs most abundantly either in the veins of diorite, or in those valleys in which the diorite appears. It is not the case, however, that the auriferous sands are confined to the valleys—they extend to the hill-summits, and are found capping the mountains even where these exhibit distinct escarpments.

Generally in the Russian alluvial deposits containing gold, the quartz pebbles and fragments are those which yield most considerably. Occasionally large lumps (*pepitas*) are found, especially in the mines south of Miask, where several weighing from thirteen to twenty pounds have been found; and one lump was obtained in 1843, and is now at St. Petersburg, the weight of which is no less than seventy-eight pounds avoirdupois—its value therefore about £3000.

It is not, however, commonly the case in the Ural to find large lumps, the usual fragments being of small size, and only separated as in other gold-producing countries by washing—the washing seldom yielding more than thirty-

six grains of gold per ton weight of soil, and never in ordinary cases more than seventy.

The rocks in which the gold of the Ural mountains and Siberia is found are very variable in their nature, including granites, metamorphosed schists, and other igneous and altered rocks. Similar rocks re-appear in various parallels of longitude along the flanks of the Altai, and there can therefore be little doubt that the supply from this district, already so large, is not likely greatly to diminish. In China again, it is well known that large quantities of gold are obtained, and there is good reason to suppose that a pretty uniformly auriferous district extends across the whole of Northern Asia.

The annual supply of gold from Russia is not only very large, but manifestly increasing. Returns of the quantity raised and paying duty, between the years 1830 and 1842, both inclusive, gave a grand total of that period of 222,156 pounds avoirdupois (worth thirteen and a half millions sterling); but of this quantity considerably more than one-third had been obtained in the last three years of the period, and more than a fourth in the last two years, while the last year's supply (that of 1842) was admitted to exceed 32,500 pounds avoirdupois, and probably amounted in all to not less than 40,000 pounds weight, worth nearly two and a half millions sterling. Returns however have been made lately to the House of Commons, by which it appears that gold to the value of four millions sterling has been annually raised in the years since 1842 to 1846; and Sir E. Baynes, the British Consul at St. Petersburg, from whom these returns are obtained, writes with reference to future prospects:—"It is said that new mines have been discovered in the Ural, and the fact of an imperial ukase having lately forbidden the sale of public estates in the region of the auriferous sands of Siberia, justifies the inference that the government have made successful surveys in that direction, and anticipate further profitable development of the gold-washings which have been so fruitful during the last four years. Under these circumstances, it would seem reasonable to expect an increase of supply, of which, however, it is quite impossible to estimate either the proportion or the continuance."

The gold found in Europe at present out of Russia is not of sufficient importance to enter into any calculation of large results, except in one or two instances. The most important of these is Transylvania, although the sands of the Moldau and other rivers of Bohemia have long been known to contain some quantity. The annual supply from Hungary has been stated by M. de Villefosse to amount to 2,810 pounds weight, the value being £176,000.

Amongst the gold districts of Europe, the valley of the Rhine between Basle and Manheim is not the least remarkable; and a recent French writer, M. Daubree, has even asserted that the richer auriferous zones may be attacked with profit.

The gravel most usually worked is that deposited at some distance below a sand-bank or gravel island which the current has eaten away, and which is the result of this abrasion. It is only in the middle of the larger gravel on the margin of the bank nearest the head of the stream, and rarely for a thickness of more than half an inch, that the gold is concentrated. The little flakes of gold are always accompanied by titaniferous iron, of which the quantity varies from 0.00002 to 0.0002, being always in proportion to the richness of the sand in gold.

Beyond the actual bed, gold also occurs in ancient deposits on the river, forming a zone of three miles in breadth; but no trace has been found either in the fine sand without flints daily deposited by the Rhine in its delta, or in the diluvial clay known under the name of *loess*.

The gold spangles are always exceedingly minute and thin, requiring from 11 to 1400 to make a grain troy, and one cubic yard containing from 5000 to 40,000 of these spangles; they appear to be derived from the crystalline schists and other rocks of the high Alps.

Compared with Siberia and South America, the auriferous gravel of the Rhine is exceedingly poor, the Siberian sands yielding five times, and those of

Chili ten times, as much ore as that obtained from the same quantity of the most productive sands of the Rhine.

The mines of Spain, anciently rich and valuable, are now neglected; and this is the case also with the sands of the Danube, the Rhone, the Tagus, and many other of the European rivers which possess gold in small quantities, but are rarely worth the expense of working. The sands are usually of black or red color, and therefore ferruginous.

The gold obtained from Africa is chiefly found between Darfur and Abyssinia, and to the south of the great desert of Sahara from the mouth of the Senegal to the Cape of Palms; but a considerable quantity is also found opposite Madagascar on the Mozambique coast between latitude 25° and 22° south. Some of the same precious metal is found in the sands of the Gambia, the Senegal, and the Niger, and the Gold Coast near the equator has long yielded the traders to that part of the world large quantities of gold dust. The whole supply from this continent is estimated at about 5000 lbs. weight avoirdupois (value £300,000 sterling.)

The supply of gold from Asia is not confined to the plains of Siberia, since the rivers of Lydia and other parts of Asia Minor, the numerous islands in the Indian Ocean, and the peninsula of Hindostan, have supplied very large quantities. This is also the case with regard to the kingdom of Siam, part of the Chinese empire, and a wide tract in Cochin China. As much as a thousand pounds weight are collected annually in Sumatra, and probably a very large quantity from the other localities mentioned.

THE POOD OF RUSSIA.

The Russian measure, the pood, is about 36 lbs. avoirdupois, and the gold produce of Russia in 1846 was—Private mining, 1,490 poods; public mining, 187 — 1,677 poods. The total quantity obtained in 1847 was 1,779 poods. The produce in the ten years, 1837–46, was 8,387 poods of fine gold, amounting to 366,848 lbs., value £18,761,310. The produce of platinum in 1848 was 213 poods — 7,668 lbs.; and the quantity of silver obtained in 1847 was 1190 poods.

THE MINTS OF FRANCE.*

France possesses seven mints; before 1814 there were as many as eighteen, but at that period eleven were suppressed, including the following among others,—Bayonne, La Rochelle, Limoges, Nantes, Perpignan, and Toulouse. Each of the existing establishments made use of a peculiar mark on its coinage to designate the mint in which it is struck. Thus the coins of the Paris mint bear the letter A; Rouen, B; Lyons, D; Bordeaux, K; Strasbourg, BB; Marseilles, MM; Lille, W. But of these seven, Paris is the only mint that has kept up an uninterrupted coinage of gold and silver money; and it is only since the copper coinage was re-melted that the provincial mints have evinced any activity.

It is a known fact, that the coinage in France is not undertaken by the State, but by contractors, who are styled Directors of the Manufacture, and who are subjected to a system of superintendence and registration.

The State allows them for cost of coinage at the rate of a franc and a half per kilog. of silver (about 2 lbs.,) and six francs for the same weight of gold. The directors of the mint are required to supply one-fortieth of the silver coinage in fractional parts of the five-franc piece; that is to say, 25,000 francs worth out of every million of francs. It is thus distributed,—5250 francs worth (or about 210*l.*) of 2 franc pieces; 12,250 francs worth (or 490*l.*) of franc pieces; 6250 francs worth (or 250*l.*) of pieces of 50 centimes; and 1280 francs worth (or 50*l.*) of pieces of 20 centimes. The tenth part of the gold coinage is to be in 10 franc pieces. The cost of the copper coinage is a franc and a half (about 1*s* 3*d.*) per 10,000 francs worth (or 400*l.*) It is difficult to

* From the London Mechanics' Magazine, October, 1854.

form an idea of the magnitude of the arrangements of the Paris mint. The results already attained are astonishing; nor less so are those within the reach of its machinery, such as the furnaces, crucibles, rolling mills, presses, milling and cutting apparatus, &c., which are contained in a comparatively small compass. Two steam-engines of 30 horse power work the various apparatuses which prepare the strips for feeding the coining presses. Each press, attended by a single workman, strikes off 50 coins per minute, and might be made to work off 60 by slightly increasing the speed. It is calculated that if each press were to strike off 50 coins per minute during 12 hours per day for 300 days in the year, the 16 presses would produce nearly 3,500,000,000 francs (or 140,000,000*l.*) worth of 20 franc pieces; 1,700,000,000 francs (or 68,000,000*l.*) worth of 10 franc pieces; 864,000,000 francs (or 34,560,000*l.*) worth of five franc pieces; 639,360,000 francs (or 25,574,400*l.*) worth of pieces of 2 francs, 1 franc, 50 and 20 centimes; and above 31,000,000 (or 1,240,000*l.*) worth of pieces of 5, 2, and 1 centime.—*Translated from Moniteur Industriel.*

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LAKE SUPERIOR REGION.

The reports from the Lake Superior region are of a very favorable character. The interest taken in mining pursuits is not less than any previous year. Indeed the activity there is well described in the following remarks of the *Lake Superior Journal.*

The amount of work performed does not in the least fall behind that of any previous year. The excitement and speculative feeling attendant upon the first discoveries of Copper having subsided, those companies which have made good selections are prosecuting the work of developing their lodes to a successful issue. More attention is being given to the importance of giving the work permanency, and thus eventually securing the greatest possible returns, than heretofore, and the natural consequence is a healthful state of feeling among Stockholders, and a willingness to come promptly forward and advance the means necessary to secure so desirable a result. One feature in the business we have been much pleased to notice and commend, which is, the fact that individual Stockholders are manifesting their interest in the mines by a personal examination of the workings, and carefully ascertaining the precise condition of the finances of the mines. Judging from the expressions of satisfaction which fall from them, we must conclude that their researches have terminated in such a way as to fully convince them of the great value of their investments.

It must not be supposed, however, that the business of exploring the country for the purpose of finding and opening new veins has been suspended. We are informed by those who have paid some little attention to this branch of business, that the country is being explored and surveyed more thoroughly than ever before. The number of those engaged in explorations is not as great, but the manner in which those at work are proceeding gives evidence that the examination of the country will be more particular and searching. Science is being brought to the aid of these men, and no available points will be overlooked. That there are deposits of metal yet undiscovered which will equal if not surpass those already brought, is the confident belief of all who have paid any attention to the present working of the country; ere long these will be discovered, opened and worked.

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Norwich Mine.—The accounts from this mine are unusually promising in their character.

This mine is being worked steadily, and that the force of men employed is sufficient to make the most rapid development possible of Copper. The number of men worked all total, is 140, and the amount of Copper shipped during the season this far is a sufficient commentary upon the way in which they have been employed. One hundred and fifty tons of Copper have already been shipped below and the amount now ready for shipment will reach thirty tons. The total amount of Copper which will be shipped from this mine during the present season cannot be less than two hundred and ten tons. Those holding Stock are confident that another season will see the mine a paying concern.

Windsor Mine.—The news from this mine is of a very encouraging nature, The Kiln House, Stamp House, and Engine House are now finished, and another week will see the Railroad in operation. The Adit Level is nearly completed, and we may expect soon to notice shipments of Copper. A considerable quantity is now in sight but the difficulty of raising the masses to the top of the bluff, and lowering them down again has operated to deter operations until the completion of the Adit.

Copper Falls Mine.—The flying reports in relation to this mine, which operated so successfully in depreciating the Stock are beginning to be exposed, and as a consequence the Stock has commenced to rise again. Over two hundred and eighty thousand dollars have been expended in opening and developing this mine, and all may rest assured that the Directors and Agents will leave no means untried to render it a profitable mine. The shipments are large, and the openings bid fair to realize sanguine expectations.

Cliff Mine.—The Cliff Mine has shown a mass of pure Copper which has been computed to contain five hundred tons. Two hundred tons have already been taken off the mass. There about five hundred tons of masses in sight besides this. The Company are about cutting a shaft through to another vein which has been discovered, and said to be much richer than the one which they have been working. This mine must hurry up or it will lose its place in the first rank of Lake Superior mines.

PHŒNIX MINE.

The Report of Mr. S. W. Hill, on this property, is so valuable, that we have made room for it almost entire.

The Phœnix location is more favorably situated, in nearly all respects, than any other in the Lake Superior region. It is embraced in sections 19 and 30, fractional section 17, and the north-west and south-east quarters of section 20, in township 58 north, of range 31 west, and is bounded on the west, by the Pittsburg and Boston Mining Company's property, on the south, by the locations of the Bay State and Eureka Companies, on the east by the Humboldt and Meadow Companies' lands, and on the north by Lake Superior. It contains 1701 acres, and has, in the north-west part, the port of Eagle River, where the supplies, materials, and copper of the mines in the neighborhood, are received and shipped. It is well timbered and well watered in all parts, and has a soil, for the most part, adapted to the wants of a mining population. The location has a gentle slope to the north, or towards the lake, and is chiefly on the north side of the northern trappean ridge of Keweenaw Point. Its altitude rarely exceeds, in any part, 550 feet above the lake, and more generally not over 350 feet. Eagle River—the principal stream in the region of the Eagle River Mines—runs through it, and furnishes an ample supply of water for all purposes in the use of machinery. At and near the mouth of this river, the banks are not more than 6 to 10 feet in height; but for about half a mile to the north of the old Phœnix mines, they are much

higher and quite precipitous. Near the old mine, and to the south of it, they are low, and the river easily accessible. There are numerous falls in the river, varying from a few feet in height to thirty and forty feet. At some of these falls, and at a very moderate expense, the river may be turned into canals, and carried to parts of the location where it can be advantageously used.

Along and near the lake the rock formation is conglomerate and sandstone, having a width inland of from one fourth to one half mile. This formation is underlaid by a thin bed of trap, at the falls in the river, a few rods above the saw-mill, and is found to extend in width, under the lake over one half mile. It is overlaid by an amygdaloid trap bed, several hundred feet in thickness, and dips northward at an angle of 24 to 26 degrees. Where this rock joins the trap above the saw-mill, a quarry has been opened in it. The stone is found to be durable, and easily quarried. It has been used in the construction of buildings in the town of Eagle River; and of late an application has been made by builders in Detroit, for the use of the quarry, with a view to carrying the stone to that city. At a very little expense, a tram road can be laid between the quarry and the pier of John Senter and Company; and from thence the stone can be delivered into vessels and carried to any port on the lower lakes. Such is the situation of the quarry that no expense need ever be incurred in draining. The bed of amygdaloid which rests upon the sandstones and conglomerate rock, may be seen on the shore of the lake, four miles west of Eagle River, and on Sand Bay Point. Between these two places it forms a nearly continuous reef. At Eagle River this reef has a channel through it, of several hundred feet in width, with an abundance of water to admit vessels of any draught to the pier. To the east and west of the channel it has a considerable prominence, and is near enough to the surface of the water to break the seas during any heavy gales, thereby protecting, to a considerable extent, the improvements on the coast.

To the south, from the sandstone quarry, are several alternations of sandstone and amygdaloid trap, in the distance of about one third of a mile. These beds of trap are very soft and porous, and differ but little in character, one from another. Wherever the veins traverse these beds they have been found to contain copper and a very little silver. These beds have a very even and uniform dip northward, or towards the lake, of 25 degrees. Succeeding these beds are others, much thicker, which alternate, and differ in character from those above noticed. They are a little more firm, though soft and porous, and contain copper in the veins. The light gray porphyritic bed, being a little more firm and tough than the beds which flank it, is easily recognized, not more by its peculiar character than by a low ridge, almost unbroken—except where it is traversed by veins. For many miles to the east of this location, and as far west as I have had occasion to examine it, under this bed is a very soft, coarse, porous, and mottled trap. Succeeding this bed is one of a columnar structure, light blue, and quite hard. This bed has been studied with considerable care, through several miles of its length in the Keweenaw Point district. In consequence of its being more firm in its structure, it has to a considerable extent been found by the geologist a true guide to the locality of the more soft beds which flank it. The underlying bed—about 120 feet thick—is composed, for the most part, of an ash, thin bands of trap, thin bands of sandstone—some of them 20 inches thick—and rounded scoriaceous bodies of trap or lava. This bed has been found more or less cupriferous throughout all parts of it where seen. Its color is a reddish brown, and it is quite soft on its upper side. Between this bed and the one resting upon it, there are marks of a slipping or sliding along the line of bedding. In some places this movement has been sufficiently great to have produced open spaces between the beds, which spaces have been filled with vein minerals, constituting what is known and described as a lateral vein. Such movements along the lines of bedding of rocks, in a region where the workable metalliferous deposits traverse the formation, are known by the miner as "slides,"

and in a country where the workable deposits have a bearing and dip corresponding with that of the enclosing rocks, they are known and described as "veins" or "lodes." It is not unfrequently the case, that the veins which traverse these beds are found to have faults in them, at the junction of this scoriaceous and ash bed with the bed overlying it. It is found to be well developed in several locations east of the Phœnix. In some parts considerable ancient mine work has been done in it. There are some of these ancient excavations in this bed, about twenty rods west of the old Phœnix mines. Still farther west I have noticed parts of this band to be well filled with copper. Beneath this ash and scoriaceous bed is a bed of greenish gray trap, in which are the principal openings in the old mine. Between this and the bed of crystalline trap are several beds, which are represented in the section herewith presented. They have been examined with considerable care—as have all of the rocks shown in the section—by myself and Mr. Whittlesey, and there described in such a manner as would enable an observer to readily recognize them. The bed of crystalline trap is less than six hundred feet thick, in the Phœnix location. The veins traversing this rock, where it is firm and unbroken, are found well filled with copper. This is one of the heaviest beds of trap in the Lake Superior district. It has an unbroken line from a point, twelve miles west of the Phœnix location, to the end of Keweenaw Point. Its thickness is greater in the region of Copper Harbor than about Eagle River. By some it is thought to be non-cupriferous. Such is not the case. It will be mined eventually, along the principal veins, and be found to produce copper. It is not known to be as productive as some of the beds which underlie it. Between this bed and the trap beds which are beneath it, is a thin band of conglomerate; in the Phœnix location, but a few inches in thickness. In some parts, it exists only in patches. To the east it becomes thicker; and near the end of Keweenaw Point, is fifty feet or more in thickness. This place is known as the "Slide," among the miners working near it, on the south side of the bed of crystalline trap. Between this location and Gratiot River, the conglomerate band is rarely seen. Veins traversing these beds will not unfrequently be found to have faults in them, at the junctions of the crystalline trap with the conglomerate band. The rock beneath the "slide," in the Phœnix lands, is a bed of soft, porous trap, about seventy feet in thickness. This bed does not show itself very much, to the west. It is not seen in the Cliff Mine. To the east of the Phœnix location it becomes thicker, and may be seen as far east as to the northwest mine. In the Eagle River location it is well developed, and does not there hold copper in the veins. None of the veins in the Phœnix location are noticed to contain much copper in this bed. It is not sufficiently hard and firm to present an unbroken wall to the vein. Veins, on entering this bed, are seldom found well defined and marked through it.

The beds which succeed this soft, porous band, are those in which the Cliff Mine has been worked. They are dark colored, grained, and quite firm and tough, with alternations of amygdaloid bands, and one bed of brecciated trap and sandstone. The united thickness of these beds is about on the line of a horizontal gallery through them, eleven hundred feet. The bed of brecciated trap and sandstone may be seen in Gallery No. 5, Cliff Mine, considerably to the south of Shaft No. 1. It is in the North American Mines, in the Forty Fathoms Gallery, near shaft No. 1, and is there only about thirty feet in thickness. It is a fine grained sand, thoroughly filled with fragments of trap, some of them quite angular and sharp, with occasional fragments of sandstone, the whole mass thoroughly cemented and metamorphosed. Underlying these beds is a very dark, tough, columnar trap, nearly two hundred feet thick, on the line of a horizontal gallery through it. This bed, which is shown in the section, has been mined through, in the North American Mine. In these galleries, and in some of the winzes, the vein in this bed has every where been found pinched, and containing but little copper. This bed

will be intercepted in the Cliff Mine, in due time. It has a dip to north of about twenty-five degrees—and on its upper side has a band of clay, two to six inches thick. Water follows down this clay bed or seam, as the workings extend to deeper levels. This division of the beds over and under it, may be called a "slide." Faults in the veins, at the junction of these beds, will be met with in some of the mines. Beneath this columnar bed is a good character of amygdaloid trap, in which the veins are found productive. This rock has been reached in the galleries in the North American Mine. I have had occasion to notice, very lately, this rock in the south part of that mine, and found it to hold the vein well filled with copper.

It should here be stated that all of the rocks shown in the section, of an igneous origin, have been found to hold copper in the veins traversing them. The sandstones, too, when not thick and flanked by traps on both sides, are found to hold some copper in the veins; and yet, the great body of copper in the veins is found in certain and particular beds of trap, which, viewed in the aggregate, may be truly called metalliferous zones. The thickest and heaviest of these zones yet discovered, is the one worked at the Cliff Mine. Upon either side of it are zones which, though containing copper in considerable abundance, when compared with this, for metallic richness, are poor and far less profitable. This heavy metalliferous zone is well developed in the Phœnix location, in section thirty, and is there traversed by veins, which have been seen for a distance of nearly two miles, at various places, and recognized as *great leading veins.*

The ash and scoriaceous bed, described as occurring near the old Phœnix Mine, is another of these zones, which has in all parts of it, in the veins, been found to hold more copper than the zones on either side of it. This zone is not so thick as the one above described, and differs from that in its holding copper intermixed with the rock, and not in a vein. The rocks on either side contain workable copper in the principal veins; but are not so rich as the zone in question. This ash and scoriaceous bed was worked at the Phœnix old mines as early as 1844. Shaft No. 1. was sunk in it. A shallow gallery was opened in it, from the bed of the river to Shaft No. 1. A small vein to the west of the main lode, was there taken for the true one. This small vein bears N. 82° W. During the years 1844 and 1845, the whole mine-work of the Company was in this branch vein, and in the metalliferous bed. Dr. Jackson, in his Report to the Company in November, 1845, mentions this place as being without walls, and having a width of eleven feet. He says,—"It was obvious that the rock, in which that shaft is sunk, is not a part of the vein, but is wall rock, impregnated with numerous globules of copper, and traversed by small string veins of metallic copper." The copper and silver which he mentions as being found in a rotten rock, came from the middle part of this bed. In another part of his report, he states that the vein, "at its south-eastern end, is well walled," by the "feldspathic and chloritic rock." The works were there in branches and strings, and in the "rotten rocks," a few feet to the west of the main vein. This bed was penetrated early in the year 1851, in the Ward vein, sixty to eighty rods west of the Old Mine, where it was found well charged with copper, and several feet in thickness. To the west of one of the old shafts of the mine, a large excavation was made in the years 1845 and 1846, in this bed for mixed rock and copper. Copper was found in sufficient abundance to have paid expense of mining it, had the true character of the deposit at that time been known. It has been mined at the Copper Falls to some extent, and will be, in due time, wrought extensively. It can be profitably worked in the Phœnix location, by levels sent out in it, both ways, from galleries in the veins, which traverse the country.

It will be seen by referring to the section, that the chief openings in the Old Mine are in the greenish gray bed of trap, beneath the metalliferous bed, in which gray bed the vein was found to be small, and in some parts rotten, carrying but little copper, and underlying to the west more rapidly than in the rocks above, or beneath. Wherever the vein was opened in the ash bed,

it was always found to be very wide, and well filled with copper in small masses, bunches, and mixed with rock. I have noticed the vein over eight feet wide, in this bed, near Shaft No. 2, and near the surface of the rock.

Near Shaft No. 4, is a fall in the river of twelve feet in height, over the gray trap, into the back of the vein in the ash and scoriaceous bed; and from that point northward, the vein has been excavated along its back, by water, to the depth of thirty-three feet below its present bed; and in length several hundred feet. This ancient channel seems to have been along the back of the vein, as far to the northward, as to the upper part of the soft mottled bed, and then bearing to the west of the vein, in the direction of the first falls in the river above its mouth, and thence along the present river channel, to the lake. The vein, in the bed of rock in which Shaft B. has been sunk, has not been excavated in its back, nor is there any trace of this channel along the vein in this bed. It would seem that water had rushed through, and excavated this channel, before the coarse drift came into the surface of the rock. We find in it, very large boulders of various kinds of rock, together with small ones, and with gravel and sand promiscuously intermixed.

During the past season, and as the work of examination of the Company's property progressed, I became satisfied that the vein along this ancient channel, and in those rocks, required a careful investigation.

The Old Mine was worked continuously, though with but a small force, from the time of its commencement to the last part of the year 1847, when it was abandoned. In 1850, and late in that season, it was again opened, and worked until February, 1853, and then again abandoned, and some work done in other parts of the location. It has a bad site for working, being directly under the channel of the river, into which cuts have been made from the shafts and galleries, draining into the mines large quantities of water from the river. Great expense was required to keep the mine from filling with water, at a time of a flood in the river. A large stream of water was cut in the deepest workings, which more than equalled the capacity of the pumping machinery, then in use, to keep it free. The mine was then examined, in all parts, and thought not to justify the expense of erecting new and heavy machinery, with a view to its further working.

In June, 1853, a thorough examination of the location was undertaken, and not completed until during the past season. Nearly all that part of it east of the river, has but few exposures of rock. Heavy cross-cuts in the earth, on the surface of the rock, were made through the northern part. This course of working enabled the Company to discover any leading veins traversing their property. The rocks, on a line nearly east and west through the location, every where, have been seen. The principal veins discovered are, the Ward vein, the Old Phœnix vein, a vein about six hundred feet west of the Old Phœnix, a vein about nine hundred feet east of the Old Phœnix, and which runs through the gorge of Eagle River, in the crystalline trap formation, into the Bay State Company's lands,—and the East Phœnix vein. Very many other veins were discovered, and some of them may, at a future time, be found worth working. The veins above noticed, are known to have a length of a mile, and some of them of over two miles. They are of good width, and all containing more or less copper with some silver. The East Phœnix vein was discovered in 1852. But little was done in it until the season after. Soon after its discovery, a mass of copper was found in it, near the crossing of another vein, which weighed over one ton. This vein has been traced through the Phœnix lands, and through other lands to the south-east, into the Eagle River Company's location, and is there being mined with fair prospect of success. An adit gallery has been excavated in it on the Phœnix lands, over nine hundred feet. This has lain along in the alternating beds of sandstone and trap: a shaft has been sunk in it over one hundred feet, with a view to ventilate the gallery. Through all of this work, the vein has been found large, considerably rotten, and containing but little copper. To the south of this work the vein may be mined, it is believed, with success. A

few yards to the south of the Phœnix grounds, is a very deep ancient excavation in this vein. Such is the situation of this vein in the Phœnix property, that it must be mined by carrying forward the adit gallery. During the past season, no work has been done in it. Another vein between this and the Old Mine has been opened in but one place, and that by an adit in the rock, fifty feet in length. This vein is about nine hundred feet east of the old works of the Company, and bears south, twenty degrees east, the same, or nearly the same course as the other principal veins in the location. It is covered to a considerable depth with drift, south of the place where opened. It runs through a part of the north-west quarter of section twenty-nine, and has been very recently found in the Bay State lands. Not enough has been done in it there to enable me to say any thing of its value, in their lands. Where it was opened in the Phœnix lands, it contained copper, was of good width, and may be mined at a moderate expense. By continuing the gallery commenced in this vein, to the south a few hundred feet, the metalliferous, ash, and scoriaceous bed can be reached at a considerable depth below the surface. The Ward vein has been seen in several places. It is well marked through the Phœnix location, and has every where been found to contain copper. It is not so wide as some of the other veins. The vein before mentioned, six hundred feet to the west of the Old Mine, has not been opened much, except upon the south side of the crystalline trap, where a gallery was opened through the earth into the rock. It was there found two feet in width in the crystalline trap. Opposite the old works, it has been opened a little, and found to contain copper. It is very well marked on the surface, and easily traced through the lands of the Company. These veins will, eventually, be worked; at present, they should not be.

There are other veins, in which some work has been done. The Armstrong vein was worked in 1851 and 1852. It bears to the west of south, strongly; and though large, was found to have but little copper in it. The openings in it are to the north of the scoriaceous bed; they were made to extend to that bed, when a fault in the vein was met with. The fault takes place at the junction of the ash and overlying beds. The vein will be found to the west of the fault; it has a direction towards the Ward vein, and will, it is believed, unite with that vein. There is another vein, of which mention has been made in the earlier operations of the Company, known as the Foster vein. It may be seen in the bed of the river, at the foot of the second falls, below the Old Mine, where it is well filled with fine copper, and some silver. It is eighteen inches wide, and bears about the same course as the Armstrong vein, and runs in the direction of the Ward vein. These two veins will not pay expenses of working; they are mentioned here, for the reason that they have been noticed by some of the Company's earlier agents, as being of considerable value.

The Old Phœnix vein has been opened in numerous places, from the base of the ridge, on the north, to the trap beds, beneath the crystalline rock, on the south. This vein is very large in places, and is well walled. It contains copper whenever seen. An adit gallery has been commenced in it, considerably to the north of the Old Mine, and carried into the rock over three hundred feet. This is the lowest drainage which can be had without going to the shore of the lake. In this adit, the vein was, for the most part, of good width; in some parts it was rotten, and contained but little copper; in other parts, pieces of pure copper was found which would weigh ten to twenty pounds, in a good and healthy vein rock. It will be seen, by reference to the section, that the adit cannot have but a few feet of rock over it. At shaft A, the vein was penetrated to the depth of four feet, and found to be much wider and richer than in the adit. Shaft B has been opened to the depth of one hundred and fifty feet, or the point where the adit level will intercept it. In some parts of this shaft the vein was found to be four and five feet wide. In the gallery running south from the shaft, the vein was found to be very wide in all parts of it, and to contain considerable copper, with more silver than I

have noticed, in other places in the vein. Some pieces of pure copper were taken from this part of the vein, and about twenty tons of mixed rock and copper. No part of the ground here has been stoped. It was thought advisable to do no more work here, until the adit should be opened to the shaft. The workings in the upper part of the Old Mine, and in shaft B, convinced me that between these two places there is a very heavy body of copper. It can be best reached by driving forward the adit gallery, a work I shall recommend.

Between Shafts No. 4 and No. 6, is another wide deposit of vein; which, so far as can be seen, is well filled with copper. This part of the vein, for the present, and until the drainage shall be brought forward, must be worked through Shafts 6 and 7. In Shaft No. 6, the vein has been found very wide, and carrying very good stamps work. In Shaft No. 7, the vein has not been found over two and a half feet in width, but well filled with copper. Some pieces, of seventy and eighty pounds, have been taken from this part of the vein. Considerable mixed rock and copper have also been taken out. No ground has yet been stoped away in this work. The ten fathoms gallery, from Shaft No. 7, will be connected with shaft No. 6, by the opening of navigation. It is then proposed to commence stoping. The old stamping mill can be used another season, and save the expense of erecting a new one, until the mine is more extensively opened. With the use of the mill another season, some copper can be sent to market from this part of the mine.

A shaft is now sinking in the soft porous bed beneath the crystalline trap, on the south side of the ridge, in the old vein. It is proposed to sink this shaft in the beds of rock in which the Cliff Mine is working, with a view to determining the value of the vein in this part of the location. The shaft is only just commenced. The vein in it is eighteen inches in width. It contains some fine copper. It is not expected that much copper will be met with, until the beds of rock, before noticed, be intercepted.

The location has been thoroughly examined, and I am prepared to state that it can be profitably mined. I shall recommend the working of the adit in the old vein steadily, until the ash bed be intercepted; and if the Company be prepared to spend more than six or seven hundred dollars per month, I shall advise the working at Shafts 6 and 7, vigorously. The working in future upon the south side of the ridge, should depend altogether upon the discoveries made in sinking the present shaft there.

Statement of work performed upon the Phœnix Copper Company's location, together with the cost attending thereupon, from the 1st of June, 1853, to the 1st of January, 1855.

MINE WORK.		
Sunk 396 feet 6 inches, for	$4,826 00	
Drifted 3366 feet 3 in. "	11,018 78	
Stoped 5¼ fathoms, "	82 50	
Cross-cut 750 feet "	591 37	
Total expense,		$16,518 65
SURFACE EXPENSES.		
Labor on Surface, 4836¼ days,	$5,418 11	
" " by contract,	2,206 00	
Salary of Superintendent, Mining Captain, and Clerk,	4,100 00	
Total Surface Cost,		11,724 11
Total amount of Mine and Surface Cost,		$28,242 76

Included in the item of "labor by the day," is the cost of cross-cutting, by way of exploration, 2,000 feet, averaging 4 feet in width by 6 feet in depth. The item "surface labor by contract," includes the costs of all work, performed by contract, not strictly appertaining to the mine: building, farming, clearing land, making roads, timbering shafts and adits, when not performed by the miners, erecting whims, &c.

North American Mine.—This Mine is progressing finely. The tone of those in charge indicates that they expect to soon rival even the far-famed Cliff. As they are located upon the same vein the prospects are favorable.

Central Mining Company.—This Company was organized in November last. From a report which they have now issued we learn the following particulars respecting their property. Samuel W. Hill is President, and Justin Shapley, Secretary. The directors reside chiefly at Eagle Harbor.

The lands owned by the Central Mining Company are embraced in the east half of section twenty-three (23) in township fifty-eight (58) north, of range thirty-one (31) west, in the Keweenaw Point District, Lake Superior, Michigan. They are bounded on the north by the Copper Falls location, on the east and south by the North-western, and on the west by the Winthrop location, and are four and one half miles from Eagle Harbor. Their height above Lake Superior is not less than five hundred feet in any part, and they do not exceed in the greatest elevations more than seven hundred and fifty feet. In the southern part is a small stream, known as the east branch of Eagle River, from which an ample supply of water can be had for purposes of dressing copper. In the western part is another small stream, which runs to the south through these lands, and may be advantageously used about the surface of the mine.

These lands are well timbered with pine and sugar-maple, and have a soil well suited to the wants of a mine, and mine force.

There are two good wagon-roads traversing them, one running diagonally through the northern part, connecting the Copper Falls and Winthrop Mines, the other through the middle part, connecting the Winthrop and North-Western Mines.

The rock formation of these lands is the well-known varieties of the trap rock of Keweenaw Point. The crystalline trap forms a very distinct ridge through them, a little to the north of the middle part, bearing nearly east and west. This crystalline rock is not more than six hundred feet thick. To the south of this rock are the various alternating beds of granular and amygdaloid trap, extending to the south line of these lands, and having a very uniform dip to the north, below the horizon, of about twenty-five degrees. It is in these beds, a few miles to the west, where the Cliff, North American, and Eagle River Mines are working, and to the east are the North-Western, Summit, and North-West Mines.

North of the crystalline rock, and resting upon it, are a few alternations of a gray, feldspathic, porphyritic, and dark brown trap. These beds are quite soft along the lines of the larger veins which traverse them.

In November last, a shaft was commenced to be sunk in the vein seventy feet to the north of the mass of copper found in the ancient excavation, when the rock was penetrated to the depth of six feet, water was found too quick to carry forward the work of sinking, until a shallow adit gallery should be made to connect with the shaft and drain off the surface water.

On the fifteenth of November the Company was fully organized. The first meeting of the directors was held on the same day of the organization of the Company, when an instalment of ten cents per share on the stock was called for.

The first work done, after the organization of the Company, was the making of the adit drain to the shaft, which was done by cutting across the country along a shallow ravine, in sand and rock, intercepting the vein at the ancient excavation before noticed. From this point in the vein, the gallery has been extended to the shaft, exposing, a part of the distance, two masses of copper, the amount of which, now in sight, the directors think, will not vary much from twenty tons.

Since the adit drain has been made the shaft has been sunk seventy-five feet below the surface, or fifty-three feet below the adit, and a gallery extended

both ways from it, in the vein, nearly forty feet. The vein in the upper part of the shaft was found to be wide and well filled with copper, but near the bottom it was quite small. After the gallery had been opened a few feet both ways from the shaft, the vein became much larger, and is now, in the ends of the gallery, twenty inches wide, and very well filled with copper.

There was taken from the shaft, when sinking, about one ton of small mass and barrel copper; and from the shaft and gallery, to the present time, sixty tons of very good stamps work. Some barrel and stamp copper has been taken from the vein about one hundred feet to the south from the shaft.

An examination of the surface on the line of the vein has been made for a deeper adit drainage. It has been found that a gallery can be made from the surface along the line of the vein, to intercept the one at the present bottom of the shaft, and through this gallery the water may be drained from the mine above. This gallery will require to be about eight hundred feet in length, and about four hundred feet of which will be in the drift or earth, and but a few feet below the surface.

The directors recommend that another shaft be sunk in the vein at a point about two hundred feet to the north of the one now opened, and the gallery now working, to be continued in that direction, without delay, to the new shaft. The gallery south from the present shaft, may, with propriety, be continued to a point eighty feet from the shaft, but not farther at present. During the ensuing winter, the present shaft and the shaft recommended to be now commenced from the surface, should be opened to the ten fathoms' gallery, and that gallery be made to connect with the shafts. The directors think it advisable to set one party of four or six miners to stope in the back of ground south of the shaft, and over the present lower gallery. This work should be commenced at once, for it is believed that by stoping a few fathoms in that back, some twenty or more tons of copper may be taken out and sent to market this season. The mass copper already in sight in the shallow or upper adit, cannot be taken out until the vein beneath it be stoped, without some inconvenience from water, it is thought. It is not expected that all of the copper in this upper adit can be taken out this season.

The amount of mine work which the directors recommend to be done, together with such surface work as seems necessary, will require an outlay per month of from $1,000 to $1,200. This amount per month the directors recommend to be raised and expended.

There is another vein in the western part of our lands which is thought to be of considerable value. It is thought advisable to open it a little this season. If it should be found to be valuable, the site for stamping machinery, it is believed, may be considerably influenced.

TENNESSEE COPPER ORE IN ENGLAND.

The Tennessee Copper mines have sold 2000 tons of ore in Liverpool since March last. The lowest price was £20 12s. 6d, and the highest £37 10s. per ton. The prospects of the Tennessee mines are stated to be good, the yellow sulphuret ore being in great demand in England.

THE BRISTOL COPPER MINING CO.

This mine having undergone the usual round of mingled good and bad luck, has at length struck an uncommonly rich vein. From authentic source, we have procured the following interesting items of information.

They have received for the ore that has been mined from 1847 to 1855, $196,000.

The mine is relieved of water by pumps discharging 109 gallons a minute. The main shaft is 240 feet deep, and part of the water has to be lifted from

that depth to the surface; but the mine is not a wet mine, as appears by the small amount of gallons discharged per minute. The pumps themselves are worked by water-power—the power being used 1851 feet, from where it is generated, and conveying a crank motion for that distance by means of flat rods, supported occasionally on friction rollers.

By the table we give below, it appears that the yield of the mine has fluctuated excessively—but they have made some discoveries lately, and have ore *now in sight*, worth over a million of dollars, and which, with their present mining facilities, it would take them fifteen years to work out. But they contemplate enlargements, and expect to triple their mining power, and of course, might exhaust the ore with proportionate rapidity. When we say there is a million of dollars worth of *ore in sight*, we leave for the imagination of each reader to settle how much more may be hereafter discovered.

The product of last month was 30 tons of ore. *This* ore is easily smelted. The mine lies, geologically speaking, at the junction of the sandstone and granite.

Dr. Nott, the venerable and famous President of Union College, of Schenectady, is the owner of this mine. It is at present a private concern, but a charter was granted by the last legislature, providing for its being merged into a joint-stock company.

They expect to raise at Bristol, this year, 350 tons of ore. At the present yield, the mine pays a profit of about 1800 dollars a month. They use Bradford's Separator, a mechanical contrivance by which a peculiar motion is given to a pan, which separates the ore from the sand. The ore is crushed by means of a pair of rollers; one roller of the pair is movable, and held to the other by means of a lever and weight. The stamps consist of a series of vertical pestles, which are tossed up and down by means of cams or wipers on the axle or stamper shaft; the lower end of the stamper is provided with a cast-iron foot-piece—chilled iron; each pestle, or stamper, weighs about 350 lbs.; the pestles work in a wooden trough, and the stuff is thrown out through a grating by force of the pestle and a stream of water. This machinery is worked by an eight-horse power steam-engine.

The ore is smelted by a New Haven Company, at their smelting-works in East Haven.

The cobalt and nickel mine at Middle Haddam, is said to be doing well and to be a very promising mine. It will probably make a dividend to its stockholders before the year is out. Nickel is worth over 300 dollars a ton. Dr. E. Franckfort is said to be the very competent manager of this mine.

YIELD OF THE BRISTOL MINE.

Year.	Tons.	Per cent. of metallic copper.	Price per cent.	Average value. per ton.	
1847	128	41,13	$3,27	$137,01	
1848	583	31,76	3,21	103,15	
1849	366	44,67	3,37 1-2	146,99 1-4	
1850	161	30,80	3,13	93,56	
1851	50	17,55	2,75	48,28	
1852	32	29,58	3,45	100,50	
1853	136	27,41	3,91	107,55	
1854	139	27,33	4,95	136,03	
1855	167				to Aug. 1, 1855.

—*Hartford Courant.*

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

BILL OF LADING OF MACHINERY AND MINING SUPPLIES,

Shipped from Philadelphia to Brasos, St. Jago, for the Vallecillo Silver Mining Company.

Names of articles packed in boxes, numbered from 1 to 60 inclusive, for the Engine of the Vallecillo Silver Mining Company, which was manufactured by Thomas, Corson & West, Norristown, Pa.

Box 1.—4 slides for horns; 6 caps for arbors; 5 cross heads; 6 bolts for arbor cornice, stuffing boxes; 10 keys for cheeks, eyes, horns, and handles; 2 keys for plug-rod, cross-head; 8 catchers, pins and washers for handles; 1 spindle pin and 2 nuts for exhaust valve; 1 equilibrium lever; 1 cheek for do. to connect to cross-head; 2 quadrants for catchers; 2 guides and 4 bolts for cataract; 8 stuffing box bolts for cylinder head.

Box 2.—2 slide rods for lifting exhaust valve; 2 do. steam and equilibrium valves; 3 arbors for handles; 2 rods for lifting steam and equilibrium valves; 1 cataract rod with brass urn; 1 balance rod for exhaust; 1 wrench and key for tightening piston; 3 horns for shutting valves; 1 cannon for lifting exhaust valve.

Box 3.—2 slide rods for lifting valves; 1 cataract loop and brass head; 10 gauge-cocks, 5 balance eyes, and 1 steam lever and cheek; 10 nuts for valve spindles and 1 rod for injection; 2 pins for brackets of equalizing and steam valves; 1 pin and key for exhaust valve; 4 screw cheeks for piston; 1 quadrant for catches; 1 eye for slide; 1 spindle cap for governor cap; 1 do. for steam valve; 1 do. for equalizing valve.

Box 4.—110 1½ inch flange bolts.

Box 5.—110 1½ inch "

Box 6.—110 1½ inch "

Box 7.—70 1½ inch flange bolts; 14 1½ inch caps for main rod.

Box 8.—48 ¾ by 9½ inch bolts for by-rods; 20 1 by 9½ inch do.; 12 1½ inch tops for shutters.

Box 9.—48½ 1 by 17½ inch rod bolts.

Box 10.—52 1½ by 17½ inch rod bolts.

Box 11.—50 1½ by 17½ inch rod bolts for main rod.

Box 12.—33 1½ by 17½ inch do.; 9 1 inch balance beam bolts; 1 ¾ inch do.; 8 1 inch do.; 6 stuffing box bolts.

Box 13.—23 bolts for steam chest; 12 ¾ inch bolt tops; 12 1 inch do.; 12 ½ inch do.; 12 1½ inch do.; 17 ½ inch bolts, for bolting air pumps; 16 ¾ inch bolts, for top and bottom of column; 4 ¾ inch bolts, for brackets of exhaust lever; 4 ½ inch wood screws for lever guides; 6 ½ inch bracket screws connected to steam chest; 19 bolts for cylinder.

Box 14.—21 bolts for cylinder; 2 do. for raising cataract lever.

Box 15.—2 plug rods.

Box 16.—48 1½ inch bolts for balance box.

Box 17.—36 1 inch bolts for caps of shears.

Box 18.—2 buckets and clasp-joints for "drawing lift," 3 bottom valves for "plunger-lift," 3 pins for seatings.

Box 19.—2 gibs and 1 key for main rod; 1 pin for balance bob; 16 bolts and nuts for bob.

Box 20.—equalizing valve and sheet.

Box 21.—2 ¾ by 23 inch bolts with 2 washers for capstan shears; 2 ½ by 18 inch bolts with 2 washers for capstan shears; 15 ½ by 12½ inch bolts with 1 washer for capstan shears; 4 1 by 18 inch bolts with 1 washer for capstan shears; 4 1½ by 2½ inch bolts with 1 washer for capstan shears; 12 1½ by 22 inch bolts for capstan shears; 2 brackets for levers of valves; 8 bolts for door piece.

Box 23.—12 ¾ by 9 inch bolts for capstan; 5 ½ by 18 inch bolts for capstan and shears; 161 joint bolts; 12 washers; 169 bolts for boiler joints.

Box 24.—exhaust valve and seat.

Box 25.—steam valve and seat.

Box 26.—28 glands for connection of by rods; 6 glands (short); 3 staples and glands for capstan; 4 keys for piston-rods.

Box 27.—1 arbor post.

Box 28.—1 arbor post.

Box 29.—1 piston rod.

Box 30.—10 glands for balance bob.

Box 31.—screw staples for balance bob connections.

Box 32.—2 columns for cataract; 2 handles; 1 horn; 1 exhaust lever; 2 glands for plug-rod; 2 eyes for steam slide; 1 eye for steam slide; 1 governor wheel; 1 gland for air pump.

Box 33.—8 screw staples; 10 tops for staples.

Box 34.—3 spindles and arches for throttle valve; 2 pedestal guides for plug-rods; 3 glands for throttle valve stuffing box; 18 bolts for caps for do.; 9 bolts for stuffing box; 2 pieces gas tubes for oil cups; 1 bracket and pin for exhaust lever; 1 blow-off cock for warming tube; 2 pieces gas-tube screwed for cataract; 3 levers; 6 cheeks for levers; 3 stuffing-box bolts for feed pumps; 2 stops for steam chest; 8 stuffing-box bolts for floating cover.

Box 35.—2 gibs and keys for main straps by-rods; 4 pedestals for capstan sheaves; 1 feed pump; 2 levers for regulating cocks in cataracts; 1 strap for feed valves; 1 cheek and lever for injection valve; 2 saddles and brasses for by-rods; 2 guides for steam levers.

Box 36.—1 throttle valve; 2 feed valve seatings and 2 guards; 3 safety valves guides and bolts; 1 oil cup.

Box 37.—1 throttle valve and 2 seatings.

Box 38.—1 throttle valve and seating; 1 injection valve; 1 lantern-brass; 1 oil cup.

Box 39.—1 long connection-rod for exhaust valve; 2 long rods for cheeks of cataract cocks; 4 main straps for by-rods; 6 straps for span beam of capstan; 6 rods for cataract; 4 levers and 4 stands for cataract; 1 cross head, 2 slide rods and 2 pins for feed poles; 2 arbors and 1 pin for lever of cataract.

Box 40.—6 wheels for piston; 1 bucket hoop; 1 pedestal for governor wheel.

Box 41.—4 set screws for cylinder girders.

Box 42.—Injection valve, seat, and pump; 2 caps for feed valves; 2 weights for safety valves.

Box 43.—1 valve cap with glands; 6 stuffing box bolts; 2 handles for false cap; 2 gas tube joints for cataracts.

Box 44.—3 safety valve pipes and seatings; 3 balance boxes; 3 cataract boxes poles and cases; 1 injection cock; 1 bucket hoop; 1 air pump bucket, and rod complete; 6 sq. washers for hold down screws; 1 weight for safety valve; 2 brass cocks for cataracts; 1 gas fitter's tongs; 4 keys for draft lifts and clack seats; 2 steps for capstan; 4 eye bolts for levels; 1 small stay for balance of exhaust valve.

Box 45.—6 miners' drills (octagonal cast steel); 6 miners' mallets (steel faced); 6 miners' picks (steel faced and pointed); 1 rod for feed lift pole.

Box 46.—1 governor valve and case complete; 1 guide for feedpole; 1 gland for do.; 6 bolts for steam pipe joints.

Box 47.—1 feed lift pole.

Box 48.—1 blank flange for steam pipe; 1 cap and valve for exhaust; 8 bolts for stands of cataracts; 4 keys for cataract levers.

Box 49.—1 equilibrium cap gland; 8 stuffing box bolts.

Box 50.—4 stop cocks, 5 nipples, 4 sockets, and 6 locknuts; 3 bends, 1 gland for balance bob, and 1 stuffing box; 2 wrought iron flanges.

Box 51.—1 false cap for cylinder.

Box 52.—19 ps. 2½ inch gas tube; 12 small gas tubes, 1 stop-cock, 5 sockets and 3 locknuts; 1 gland for balance bob.

Box 53.—18 sheaves for dampers; 6 bends gas tube.

Box 54.—14 ps. large gas tube, 3 sockets, 3 stop-cocks; 1 locknut, 2½ in t's, 3 sockets, and 3 locknuts.

Box 55.—2 packing-rings.

Box 56.—Boiler rivets for water tank, 200 lbs.; 1 jet pipe for injection.

Box 57.—4 handles for crab winches; 6 bolts for do.; 4 guards for do.; 4 bolts for do.; 1 clevis bolt and key for triangle; 2 rings for triangle; 2 eye bolts for triangle; 2 washers for do.

Box 58.—Iron borings for cementing joints.

Box 59.—Iron borings for cementing joints.

Box 60.—16 bolts for crab winch frames; 2 bolts for truck winch frames; 29 plain pumps, wrought iron riveted with cast iron flanges; 1 matching piece, wrought iron riveted with cast iron flanges; 2 wind bores, wrought iron riveted with cast iron flanges; 1 box containing 14 inch plunger; 1 plunger case; 2 working barrel bored, &c., 18 ft. by 14 inches; 2 girders for supporting cylinder; 4 jack screw columns; 1 centre piece for capstan; 4 dampers and frames; 1 damper and frame heavy; 2 door pieces and doors; 1 h. piece and doors; 1 blank flange h. piece; 2 steam pipes 11 ft. by 14 inches; 1 eduction pipe; 1 stuffing box and gland; 2 faucet steam pipes; 1 axle for capstan with 2 gudgeons and rings; 3 valve chambers (for stop valves); 3 blank flanges (for stop valves); 3 bend steam pipes; 36 strapping plates 6 by 1 inch; 8 strapping plates 4 by 1 inch; 2 5 ft. pulleys with turned wrought iron gudgeons; 1 5 ft. pulley with turned bored iron gudgeon; 1 equalizing pipe; 1 cross-head for piston rods; 1 cross-head for air pumps; 1 air pump; 1 hot well; 1 bed plate for arbor posts; 1 piece cornice for arbor posts; 2 pieces cornice for arbor posts; 2 main straps for main rod; 4 pedestals for balance bobs; 2 pins for carrying air pump; 3 check valves for feed pipes; 4 check seats and valves; 8 plates for by-rods; 8 plates with screws at one end for caps of shears; 1 ½ turn steam pipe; 2 balance bob gudgeons; 2 nose plates and bolts; 4 stay plates for bolts; 1 cylinder cap; 1 piston; 2 pieces follower: 17 square fire grates; 2 boilers; 1 pair large iron blocks: 6 plates for boilers; 1 set-off for pump; 8 braces for capstan arms; 2 balance weights for handles.

The following is a description of the TIMBER sent out all fitted and ironed ready to be put up:—

2	Pieces	oak timber	38	feet long by	17½	inches square		
1	"	"	43	"	12	"		
1	"	"	12	"	10	inches by	17	inches
1	"	"	16	"	10	"	7	"
1	"	"	17	"	10	"	7	"
1	"	"	16	"	9	"	7	"
1	"	"	14	"	9	"	7	"
1	"	"	17	"	8	"	7	"
1	"	"	13	"	18	"	13	"
1	"	"	44	"	14	"	14	"
1	"	white pine	36	"	15	inch square		
1	"	"	19	"	15	"		
1	"	"	41	"	15	"		
1	"	"	35	"	15	"		
1	"	"	49	"	15	"		
1	"	"	23	"	15	"		
1	"	"	45	"	15	"		
1	"	"	48	"	15	"		
2	"	"	30	"	13	"		
1	"	"	27	"	16	"		
4	"	"	29	"	7	"		
1	"	"	21	"	10	inches by	7½	inches
1	"	"	31	"	18	"	17	"
7	"	"	20	"	22	"	8	"

Assorted Iron to be used in putting up engine, machinery, and pumps in the mine, for bolts, foundations, and other purposes. Nuts, staples, glands, bands, braces, rod-plates, bucket-rods, capstan, shears, derricks, staying-of-shaft timbers, connecting-rods, picks, drills, mallets, claying-irons, scrapers, &c., &c., being an ample supply for a long period after recommencement.

1	bar	best iron	2¼	inches round		
6	"	"	2	"		
6	"	"	1¾	"		
10	"	"	1⅝	"		
10	"	"	1⅜	"		
15	"	"	1¼	"		
20	"	"	1	"		
15	"	"	⅞	"		
15	"	"	¾	"		
3	bbls.	"	⅝	"		
3	"	"	½	"		
3	"	"	⅜	"		
1	bar	"	3	inches square		
2	"	"	2½	"		
3	"	"	2	"		
3	"	"	1½	"		
3	"	"	1	"		
3	"	"	⅞	"		
3	"	"	1¼	"		
10	"	"	¾	"		
3	"	"	1⅜	"		
3	"	"	1⅛	"		
12	"	"	⅝	"		
2	bbls.	"	½	"		
3	bars	"	6	inches by	1	inch
4	"	"	5	"	¾	"
4	"	"	4	"	¾	"
10	"	"	3	"	¾	"
4	"	"	2	"	¾	"
4	"	"	2½	"	½	"
3	"	"	4	"	½	"
4	"	"	3½	"	½	"
10	"	"	2½	"	½	"
6	"	"	2	"	½	"
6	"	"	1½	"	½	"

10	bars	best iron	3	inches by	¼	inch
6	"	"	4	"	¼	"
5	"	"	3½	"	¼	"
5	"	"	3	"	¼	"
8	"	nut iron	2½	"	¾	"
8	"	"	2	"	¾	"
8	"	"	1¾	"	¾	"
10	"	"	1½	"	¾	"
15	"	"	1¼	"	¾	"
10	"	"	3½	"	½	"
10	"	"	2	"	½	"
10	"	"	1¾	"	½	"
10	"	"	1½	"	½	"
8	"	"	3	"	⅜	"
8	"	"	2½	"	⅜	"
8	"	"	2	"	⅜	"
8	"	"	1½	"	⅜	"
10	"	"	1¼	"	½	"
1	bbl.	"	1	"	½	"
3	bars	"	3	"	1½	"
10	"	"	2½	"	1¼	"
10	"	"	2½	"	1⅛	"
10	"	"	2	"	1	"
10	"	"	1¾	"	¾	"
10	"	"	1⅝	"	⅝	"
10	"	"	1½	"	½	"
20	"	"	1	"	¼	"
2	"	English steel,—				
4	"	cast steel	1	"		octagonal
2	"	"	1	inch by	⅜	inch
1	bbl.	hoop iron	1½	"		
1	"	scroll "	1	"	¼	"
4	"	band "	2	"	3-16	"
3	mason's C. S. hammers					
3	engineer's C. S. "					

2 plates best boiler iron, ½ in. by 26 in. by 8 ft.; 1 do. ⅜ in. by 26 in. by 8 ft.; 1 do. ½ in. by 32 in. by 6 ft. 8 in.; 2 double iron squares; ½ doz. mill saw files (10, 11, 12, and 14 in.); ½ doz. flat bast'd files (18 in.); 1 doz. hand saw files (4 in.); 1 doz. pit saw files (5½ in.); 3 C. S. hand saws; 2 doz. Rowland's C. S. long-handled shovels; ½ doz. do. No. 2; 2 C. S. drawing-knives; 1 cask cut nails, 12, 20; 1 cask spikes, 4½, 5, and 6 in.; 2 60 ft. tape measures; 1 molasses gate; 1 screwed wrench (12 and 18 in.); ½ doz. mason's trowels; 2 four-fold rules; 39 augers (ass'td sizes); 12 handles for do.; 15 lbs. copper tacks; 48 lines; 6 slice knives; 2 brass plumb bobs; 4 iron do.; 2 brass bound rules; 2 machinist's squares; 6 paint brushes; 3 cooper's compasses; 3 carpenter's do.; 2 wrenches; 5 pair callipers; 6 flat bast'd files, 6 in.; 6 do. 7 in.; 24 do. 14 in.; 6 do. 2d cut files, 10 in.; 12 ½ round files, 14½ in.; 1 Stubs' hack-saw frames; 3 Stubs' hack-saw blades; 2 hand-vices; 1 bench vice; 6 lanterns; 7 Beatty's chisels (assorted sizes); 1 carpenter's adze; 2 melting ladles; 1 ½ round rasp; 1 horse rasp; 10 lbs. horse-shoe nails; 2 sledge hammers; 1 C. S. chipping-hammer; 1 C. S. forging do.; 5 ½ round dead smooth files, 15 in.; 3 equalizing do. 18 in.; 72 file-handles; 1 bench screw; 1 pickaxe and handles; 1 ratchet drill; 6 spirit levels; 1 cylinder seat; 7 dampers and frames; 1 door piece; 2 doors for do.; 4 frames for crab-winches; 2 small shafts for do.; 2 large shafts for do.; 2 barrels and cog wheels for do.; 2 clack seats and valves; 1 air-pump cover; 1 steam-chest; 1 condenser; 1 bottom plank for tank; 10 sheets boiler iron for do.; 1 1st steam pipe; 1 sheave pully for capstan rope; 2 rolls for truck; 2 pieces oak timber 8 ft. by 6 in. by 7 in. for truck frames; 2 do. 3½ ft. by 6 in. by 7 in. for do.; 4 do. 10 ft. by 5 in. by 6 in. for winch frames; 4 do. 3½ ft. by 5 in. by 6 in. for do.; 1 boiler; 1 cylinder; 1 steam jacket; 4 stay plates for balance beam; 1 junction pipe for injection; 1 coil 12 in. fine yarn Russia rope, 4 strands, slightly tarred; 1 chain 9-16, 250 feet long; 1 do. ½, 36 feet long; 1 coil 6 in. Manilla rope; 1 coil 5 in. do.; 1 coil 3 in. do.; 1 coil 4½ in. do.; 1 coil 3½ in. do.; 1 single 10 in. iron sheave iron-strapped block; 1 double 10 in. do.; 1 box containing 12 Yankee axes; 24 turned hickory helves; 6 bench-hatchets, "No. 6"; 6 yards ½ in. India-rubbing packing; 1 keg red lead, 100 lbs.; 1 keg white lead, 100 lbs.; 289 lbs. pig lead; 6 coils of packing yarn; 6 copper oil feeders, "pints"; 6 do. "quarts"; 3 tin oil feeders, "gallons"; 6 hides butt leather; 1 barrel "rape oil," 34 galls.; 2 2 in. jack screws; 2 chain clews; 12 cedar steam-bottomed pails; 2 polished screw wrenches; 2 steel chipping-hammers; 2 C. S. nail hammers; 10 6 gallon kegs and 2 5 gallon kegs; 2 140 gallon barrels; 1 box containing 25 Mississippi rifles for personal defence against the Indians; 1 box containing nest of wooden bowls for washing silver; 2 large and 1 small set of wheels made specially for moving heavy parts of machinery; 2 pair wood blocks; 1 coil rope, 1½ diam. for blocks; 1 do. 1 diam. for blocks; 1 bale Italian hemp for packing; 6 wrought-iron wheelbarrow wheels; 1 barrel pitch for joint rings of pumps; 1 barrel of tar for do.; 700 ft. 2 inch pine plank, dressed and fitted, for casing of steam cylinder; 3 kegs cut nails, 10, 20, 40; 3 kegs cut spikes, 4, 5, and 6 in.

AGGREGATE WEIGHT OF THE PRECEDING BILL OF LADING.

60 inch cylinder	12,400	lbs.
steam jacket for do	2,980	"
cylinder seat	5,225	"
cylinder cap	1,616	"
cylinder false cap	944	"
piston	1,212	"
piston rods	1,800	"
3 stop valves	3,400	"
2 arbor posts	1,400	"
1 bottom plate for cistern	2,170	"
4 screw braces	2,155	"
1 cross-head	2,180	"
1 steam chest	2,935	"
1 air pump	2,696	"
steam pipes	14,661	"
sundry small articles mostly packed in boxes	25,330	"
3 boilers 7 by 10 feet, 6,324 lbs. each	18,972	"
3 top plates for boilers / 3 bottom plates for do.	8,940	"
1 condenser	875	"
1 heater	2,500	"
1 bed plate	850	"
2 girders for engine house	8,800	"
1 centre piece for capstan	1,740	"
2 gudgeon blocks	2,605	"
bolts for pump-rods, balance beam, &c	5,255	"
strapping plates for pumprods, connections, &c	21,200	"
15 graters	2,300	"
pumps, 10 " 15½ inch wrought-iron plain pumps / 2 " 14 " " "	29,400	"

WORKING PARTS FOR PLUNGER SIFT.

1 14 inch plunger	1,872	"
1 14 inch H piece	3,400	"
1 14 inch door piece	2,180	"
2 doors for door piece	1,160	"
1 plunger case	2,380	"
1 flange	290	"
1 stuffing-box and gland	760	"
3 valve seats and 6 valves	1,588	"
1 wind-bore	2,100	"

WORKING PARTS FOR DRAWING SIFT.

1 14 inch working barrel	3,070	"
1 door piece and door	2,785	"
1 wind-bore	3,190	"
2 valve seats and 4 valves	974	"
bucket prongs, clasp-joints, bottom valves, &c., of wrought iron	444	"

SPARE ARTICLES FOR PUMPS.

1 14 inch wind-bore	3,085	"
1 14 inch door piece and door	2,780	"
1 seating and 2 valves	487	"
flange-bolts and nuts for pumps	2,100	"

EXTRA ARTICLES.

1 crab winch	1,300	"
1 pair large iron blocks	325	"
39 pieces of timber for beams, connecting-rods, capstan, shears, &c	50,000	"

CORDAGE.

1 hawser 700 feet long, 12 inches drain, with assorted cordage and chains for whims (Malecates,) blocks, shears, crabs, &c., &c., (about)	15,000	"
assorted iron miner's tools, and every description of mining supplies	44,800	"
	339,448	"

DOLORES MINES.

To change the machinery at the Dolores Mine from a lifting to a forcing pump, and in other points to render it efficient, and in all respects worthy of the mine in which it is placed—the following pieces, with their weights attached, will complete the work.

1 pump, shaft and crank	3,000	lbs.
1 pinion wheel for do	1,647	"
1 pinion	220	"
2 pedestal and brasses	2,274	"
2 bishop heads and pins	390	"
2 nose plates and pins	360	"
2 gudgeons and pedestals	1,180	"
3 forked connections and brasses	890	"
3 pair plates and brasses	980	"
1 3 inch feed pump for engine,		
2 set fine bars, (60, each 100 lbs.)	6,000	"
1 plunge bottom, complete	7,111	"
2 wind bores for draining left	2,600	"
2 door pieces and doors for do	2,850	"
2 working barrels " "	2,850	"
10 plain pumps " "	10,000	"
2 matching " "	1,080	"
4 brass buckets complete	256	"
6 clasp joints for pump rods	120	"
2 set-offs	170	"

E. DUPLICATE PARTS FOR DRAINING LIFTS.

2 wind bores	2,600	"
2 door pieces and doors	2,350	"
2 working barrels	2,850	"
2 plain pumps	6,000	"
4 clasp joints	80	"
1 brass bucket complete	64	"
Total,	56,862	"
Total machinery and mining supplies of both mines	296,805	"

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

Shipments by Reading Railroad, to August 16th	1,470,324 01	tons.
" Schuylkill Canal,	621,122 16	"
Total	2,091,446 17	"
Same time last year	1,855,144 03	"
Increase	236,302 14	"

LEHIGH COAL TRADE TO AUGUST 11TH.

Summit Mines,	183,422 15	tons.
East Lehigh,	25,998 05	"
Room Run Mines,	43,521 16	"
Beaver Meadow,	25,365 07	"
Spring Mountain Coal,	90,615 03	"
Colerain Coal,	51,279 13	"
Stafford Coal,	6,610 00	"
East Sugar Loaf Company,	27,850 03	"
New York and Lehigh Company,	18,868 13	"
French American Coal Company,	3,058 18	"
A. Lathrop's Pea Coal,	1,615 07	"
Hazelton Coal Company,	81,756 07	"
Cranberry Coal Company,	42,380 15	"
Diamond Coal Company,	13,610 04	"
Buck Mountain Coal,	39,391 08	"
Wilkesbarre Coal Company,	24,775 17	"
Total,	683,033 05	
Last year,	625,577 08	"
Increase in 1855, so far,	57,455 17	"

WYOMING COAL TRADE TO AUGUST 11TH.

We glean the following from the *Record of the Times*, published at Wilkesbarre:—Shipped for the week ending Saturday last, down the river:

	Week.	Total.
Pittston Coal Trade,	12,938	77,958
Wilkesbarre,	11,895	76,887
Plymouth,	6,654	31,379
Nanticoke,	3,799	28,600
Total,	35,281	214,819

The quantity of coal sent to market from Scranton up to the first of June was 71,362 tons, against 48,070 tons to same period last year. This coal all goes into the interior of Pennsylvania and New York states and Canada.

Shamokin.—The quantity sent from this region, we learn, is between 40 and 50,000 tons so far. The increase this year over last, will range from 40 to 50,000 tons. The shipments last year were 63,500 tons. The completion of the railroad from Sunbury to Milton in all of August, will give another outlet for Shamokin coal, which will be of great advantage to that region. They will have no competition for that market from any other Anthracite region for some time to come.—*Pottsville Journal, July 28th.*

MARYLAND COAL TRADE TO AUGUST 11TH.

By the Cumberland Coal & Iron Co.'s Railroad.

	Year.
C'd C. & I. Co	102,930.02
Howard & Co	789.13
Everett & Co	4,343.18
Percy & Co	2,161.18
	110,225.11

By the Cumberland & Pennsylvania Railroad.

	Year.
Frostburg C. Co	26,723
Borden Mining Co	38,287
Allegany Mining Co	30,684
Carbon Hill C. Co	2,514
Union C. & I. Co	508
	98,666

Total from the Frostburg region for the week, 5,045.12 tons, and for the season 208,891.11 tons.

By the George's Creek Coal & Iron Company's Railroad from George's Creek Valley.

	Year.
George's Creek C. & I. Co	21,409.15
Swanton Coal & I. Co	45,632.07
American Coal Co	59,756.16
Franklin Coal Co	3,425.14
	130,224.12

By the Hampshire Coal & Iron Company's R.R. from the Hampshire mines, via Piedmont.

	Year.
Hampshire C. & I. Co	33,734.11

By the Baltimore & Ohio Railroad from the Bloomington and New Creek Collieries.

	Year.
New Creek Co	2,689.12
Bloomington Co	171.00
	2,860.12

Total from the George's Creek region for the year	166,818.15 tons.
Total from the whole coal region for the year	375,711.06 tons.

Increase about 15,000 tons over last year.

PITTSBURG COAL TRADE.

In 1853, according to the statement of the Monongahela Navigation Company, 15,716,367 bushels came through the lower lock of that improvement, to which is to be added the immense amount mined below that point, both for our own consumption and shipment. In 1854 the Board of Trade gathered all the available statistics of the coal trade, and in their memorial to Congress they stated the shipments of that year to be 23,738,906 bushels, to which the amount of home consumption has to be added. In 1855, up to this period, the amount shipped is largely in advance of the same period in 1854. Making, however, the shipment of 1854 as the basis of calculation, we are within bounds when we affirm that we mine, for all purposes, twenty-five millions of bushels of coal per annum, which is equal to one million of dollars.—*Pitts. Gaz.*

THE COAL TRADE OF CLEVELAND.

The Cleveland, Ohio, papers contend that the coal trade of that city this year will reach in the aggregate ten millions of bushels, or 400,000 tons. This coal is drawn partly from the Ohio coal fields between Youngstown and Warren; partly from the Darlington Canal coal mines in Beaver county, Pa.; and the remainder from the bituminous coal fields bordering on the Ohio River, in the neighborhood of Wellsville, Ohio. Pennsylvania bituminous coal forms a portion also of the shipments to Cleveland.

COST OF SHAFTS AND PREPARING COLLIERIES.

The expense of sinking shafts and preparing collieries in Schuylkill county, Penn., is stated very explicitly in the *Pottsville Journal*, in an article aiming to show that the large capital required by coal companies was unnecessary to mine in that region. The extracts are important for the facts they present:—

The outlay for preparing collieries, and sinking shafts, is not half so heavy as is purposely represented by speculators. The sinking of the Carey shaft at the McGinnes Colliery—a depth of less than 450 feet—did not, and should not have cost over $30,000; and with the necessary machinery to take out per day from 800 to 1,000 tons of coal, not over $75,000. Twelve years since, an estimate of the expense was made by one of our most careful coal operators, who then contemplated taking the work in hand, and he estimated the entire expense at not more than $62,000, of which sum he set apart $30,000 for sinking and preparing the shaft for work.

The Broad Mountain and Mine Hill basins are within the reach of individual enterprise, because the lowest veins do not lie deeper than from 2 to 500 feet. In the Peach Mountain and Oak Hill range, the gray ash coal can be reached at a depth of 2 to 400 feet by shafts, in the basin, although the white ash mammoth vein lies at a depth of 800 to 1,000 feet. In the third basin, south from the Broad Mountain, called the Lewis Vein Basin, the depth of a shaft to strike the red ash coal, would be only a few hundred feet, although the Mammoth white ash vein lies at a depth of from 1,000 to 1,200 feet. In the two southern basins the red ash veins can be struck at a depth of a few hundred feet, by shafts, although the Mammoth white ash vein lies at a depth of from 1,200 to 2,000 feet. We speak of the deepest portions of the basins. At the Broad Mountain basin there are 64 feet of coal, all of which can be struck at a depth of 2 or 300 feet in the deepest part of the basin.

The late Samuel B. Fisher furnished us with an estimate of the number of veins of coal in the different basins, some two years since, from which we glean the following facts:

In the Broad Mountain basin there are nine distinct veins of coal; aggregate thickness, 64 feet. This can all be reached in the deepest part of the basin, by shafts of not over 200 feet in depth.

In the Mine Hill region the number of veins is the same, with the same aggregate quantity of coal—and all reached at a depth of less than 500 feet.

In the Peach Mountain and Oak Hill range there are about 18 veins, making 102 feet of coal, all of which can be reached at from 200 to 1,000 feet from the surface.

In the southern basins there are from 25 to 27 veins (if the white and gray ash veins underlie the red ash, which it is now generally conceded they do), all of which can be reached in a shaft varying from 200 to 2,000 feet.

Now, the reader must remember that it is not necessary to sink shafts immediately, to the entire depth of the basins—particularly in the southern sections of the regions. None but an insane person (or a coal company speculator) would ever dream of such a project. If Mr. Fisher's estimate of the number of veins is correct, we have the fact that in a depth of 2,000 feet, 27 veins of coal would be penetrated, amounting in the aggregate thickness to 150 feet of coal, provided they continue of the same thickness at this depth, as they are at the points first opened.

To sink shafts in the Southern basins, of course the first vein struck would be worked, and the shaft continued to the next. The proceeds of the working of the first would pay for sinking the shaft to the second vein, and then that could be worked also. The shaft could thus progress gradually as the wants of the colliery required, and all the expenses paid out of the proceeds of the rents, with but a moderate outlay at the commencement. The upper veins must be worked out first; gangways driven from them, and the breasts worked up, to run out air shafts—these air shafts would be driven up from one vein to the other, as the different veins are worked. This is the only feasible plan by which the southern coal basin can be worked by means of shafts—and there is no greater necessity for the incorporation of companies to sink shafts than there is for sinking slopes.

The expense of shafting is about $200 a yard in this region. An operator of the Schuylkill Valley informed us a few days since, that he had offers to sink a shaft at $70 a yard—the operator finding every thing, such as pumps, &c. His estimate is, that the shaft, prepared for taking out coal, independent of the outside machinery, will cost him about $200 a yard.

LEHIGH COAL AND NAVIGATION COMPANY.

The following statement has not been inserted in these pages, and we now give it space for the convenience of reference. It is a summary of the business of the Lehigh Company last year.

The annexed statement exhibits the receipts and expenditures of the Lehigh Coal and Navigation Company for the past year, 1854:—

RECEIPTS.		
For ground rents and gain by sale of town lots,		$ 26,733 94
Net tolls,		685,097 51
Coal,		378,821 30
Net receipts,		$1,090,652 75
EXPENSES.		
Interest account,	$259,855 04	
Repairs,	149,713 11	
State tax,	7,423 80	
		416,991 95
Net earnings in 1854,		$683,660 80

This amount is nearly double that realized in the previous year.

READING RAILROAD COMPANY.

The reader will find the following article a brief and comprehensive statement respecting the Reading Railroad, which has become the most important road for the transportation of coal in the country.

The stock of the Reading Railroad Company being now the first on the list, let us examine the superstructure, location and appointments, and determine how far it may be considered as a model to all future operations of the kind in the country. Its length, as every body knows, is ninety-three miles, and besides a double track, with sidelings on the line of the road, equal to half the distance. It is laid down in the most substantial manner, with the heaviest iron rails in the country. Its grade descends twenty-two feet to a dead level, on which a single engine can haul 500 tons at a speed of ten miles per hour. Indeed, so nicely is the grading adjusted, that the full power of the engine is only required in the return of the empty cars. At the end of the road, and exactly at the point where the elevation is required for dumping facilities, a short plane, at the rate of 40 feet to the mile, is encountered. On this ascent, which, in any other position would seriously interfere with the business, three engines are required to carry up the load; and, as the fact thus tested, not only determines the advantages over undulating roads, but gives the data by which the cost can be estimated, it may be regarded as an important truth in railroad science. In all our roads the grades have been regarded as secondary objects; but now, when the expense account is running away with the dividend fund, this matter, with some others of less importance, are worthy the attention of stockholders. Besides the advantages of superstructure and grades, the location of the Reading road is peculiarly adapted to business. On the east, the branches diverging to the several collieries, including the Catawissa road, pass into it with rapidly descending grades. In the middle portion of the region like advantages present themselves in its favor; and on the south it meets not only the same facilities to the colleries, but the Mahanoy road attaching it to Sunbury and Erie, and the Dauphin and Susquehanna with the Pennsylvania Central. These works, without the main lines branching to the north and west in a connected form, extend to over 500 miles, and if we view the work as the chief outlet to the business of the valley of the Schuylkill, (the richest valley in the country, according to its length,) we will be able to determine its future business.

With a full knowledge of all these facts, and in view of the prospects which cannot be forestalled or superseded, what has been the course of the managers? Instead of securing the objects required by the trade to themselves, they anticipated the advantages and secured the railroad into the city—the depots and the wharf property, by which the capacity of the road is determined, to the stockholders. On the wharf property they have now in operation eighteen wharves, with sidelings equal to the accommodation of 8,000,000 tons of coal, and they have yet space for a similar number, which will eventually be required by the trade. For the depots, they secured two entire squares, at prices far below their present value; and as the bridge and railroad, with the right of way into the city, was obtained at one-third the cost, it cannot be said that selfishness, so fashionable in other quarters, has had any influence in the management of the Reading. The increase in the value of the property secured to the stockholders is alone estimated at from two and a half to three million of dollars. On the road, according to the report of last week's coal business, the traffic is equal to 8,000,000 tons per annum; and when their extensive worshops, their sidelings at the several depots, and their numerous stone and iron bridges, are taken into the catalogue of their assets, the astonishing part of the matter is, that the cost is but $18,164,114 64—on which the gross income this year will exceed 33 per cent.

EXHAUSTION OF THE ENGLISH COAL FIELDS.

As our various national resources have continued to increase in vigor and magnitude, and industrial enterprise has daily become more and more largely developed, so, in a perpetually increasing ratio, has been the drain, so to speak, on the precious deposits of our great carboniferous store-houses; in fact, the consumption of coal at the present period is altogether unprecedented.

Not less than 87,000,000 tons are now annually raised to meet the demand in various quarters! The value of this vast mass of the mineral extracted from the bowels of the earth by the labors of about 160,000 persons is at the pit's mouth little less than 10,000,000*l.*, at the places of consumption, including expenses of transport and other charges, probably not less than 20,000,000*l.* The capital employed in the trade exceeds 10,000,000*l.* London alone consumes upwards of 3½ millions of tons annually—about half a million of which are now brought by the Great Northern Railway; and as a proof of the rapidly-increasing consumption, a metropolitan return, which has recently been issued, shows that, in 1853, there were 3,745,345 tons brought into the port of London, against 3,490,963 tons of the preceding year. In 1850, our coasting vessels conveyed upwards of 9,360,000 tons to various ports in the United Kingdom; and 3,350,000 tons were exported to foreign countries and the British possessions. Of these, France took 612,545 tons; Holland, 159, 953 tons; Prussia, 186,528 tons; and Russia, 235,198 tons. Our ocean steamers now require very large supplies indeed; and it is calculated that 30,000 tons will be required for the use of the Baltic and Mediterranean fleets. The consumption by our manufacturing establishments is immense; and as one isolated proof of the rapidity and extent of the increase, I may mention the fact that, in the year ending Oct. 31st last, 113 new mills have been built in Lancashire; and the gross increase in the year of steam-power has been 3894 horse, requiring 15,600 additional hands!

About 400 iron-furnaces of Great Britain consume annually 10,000,000 tons of coal, and 7,000,000 tons of ironstone, in order to produce 2,500,000 tons of pig-iron, of the value of upwards of 8,000,000*l.*; and we must not be unmindful that these great smelting establishments, in order to meet the vast and growing demand for iron rails, houses, churches, ships, &c., are now constantly augmenting in number, which, with other demands, too obvious to particularize, will also tend to increase immeasurably the present consumption of coal. In short, astounding as are the statistical facts just enumerated, they assume a still more transcendent and portentous importance, when viewed in relation to the future, especially as regards the far-spreading mechanical energies, commercial movements, and spirit of universal enterprise, characterizing this great and populous country. To develope, to conservate, to investigate with jealous care this grand element of internal strength and prosperity—the *primum mobile* of our multitudinous and world-wide progressions—cannot but be considered as sacred duties by every man possessed of a single spark of patriotism in his breast. Far be it from me to exhibit any unnecessary prominence in sounding the tocsin of alarm; but it were impossible for any one at all conversant with the existing facts and prospective bearings of this subject, not to entertain some serious forebodings as to the permanent capabilities of our English coal fields. The many and laborious calculations, which, in order to arrive at some conclusive information on this vital point, have been entered into by men well versed in the matter, have resulted in but very discouraging declarations. Mr. Bakewell, than whom a more acute and accurate observer, or a sounder practical geologist never entered the field, in descanting on the bituminous deposits of the northern fields, remarks, that the period is not very remote when the coal districts, which at present supply the metropolis with fuel, will cease to yield any more. From data derived from the correctly-ascertained number and extent of the coal beds of Northumberland and Durham, it has been calculated that the coal in these counties will last but 360 years; for although there are as many as 40 distinct seams of coal in this field, but only 18 of them are considered workable, or sufficiently thick to remunerate by their produce.

Another eminent authority, Mr. Taylor, observes, that notwithstanding the enormous annual produce of the northern field, it is a very moderate calculation of its resources, to suppose that the present supply can be kept up through the next four centuries. The trade has been in existence for up-

wards of six centuries. Mr. Bailey, in his *Survey of Durham*, states, that one third of the coal being already got, the coal districts will be exhausted in 200 years. One would imagine that such gloomy conclusions would induce the utmost care to be taken in economising every particle of the mineral; yet the very reverse would appear to rule; for Mr. Holmes, in his *Treatise on Coal Mines*, states the waste of small coal at the pit's mouth to be one fourth of the whole. The waste in the mines is computed to be one third. These are facts, which alone loudly call for some sort of legislative interference.

As regards all the other known English coal fields, Mr. Bakewell, after entering into some elaborate disquisitions on the capabilities and demands of each, concludes by remarking that we may thus anticipate a period not very remote when all the English mines of coal and ironstone will be exhausted, and, continues he, "were we disposed to indulge in gloomy forebodings, like the ingenious authoress of the *Last Man*, we might draw a melancholy picture of our starving and declining population, and describe some manufacturing patriarch, like the late venerable Richard Reynolds, travelling to see the last expiring English furnace, before he emigrated to distant regions."

It is true, however, that from this discouraging picture we may, for some consolation, turn to the 100 square miles of coal providentially stored up in South Wales; but the supplies in reserve, even in this noble field, are limited.

IRON AND ZINC.

WHITE OXIDE OF ZINC AND INSTRUCTIONS FOR ITS USE.

The works of the Vielle Montagne Zinc Company in Belgium, have been described in this Magazine. Their oxide of zinc is well known to be unsurpassed. The importance and value of this substance induces us to present the following full and complete particulars respecting it.

Discovery and Manufacture.

White oxide of zinc has been known as far back as the last century, but to Mr. Leclaire, of Paris, we owe the discovery of the most practical method of its manufacture, and its fitness for painting. Mr. Leclaire having sold his patent right to the V. M. Zinc Mining Company, the latter alone have a right to manufacture white oxide of zinc by the Leclaire process, both in Europe and America.

The Various Uses of Oxides.

The oxides manufactured by the V. M. Company, at their extensive works in Belgium, France, and Upper Silesia, are—

SNOW WHITE, WHITE NO. 1, STONE GRAY, (light tint,) DARK GRAY.

Snow White—A beautiful, brilliant, and most delicate white, used for fine ornamental inside painting.

White No. 1—Nearly equal to snow white, used for all inside, also for outside work when required.

Stone Gray—Its use is naturally inferred.

Dark Gray—A semi-metallic oxide, used for priming. It is also especially adapted for painting iron work and iron ships, which it protects most effectually against corrosion.

Purity of the V. M. Oxide of Zinc.

All the white oxides of zinc manufactured by the V. M. Company are made from pure Plate Spelter, and, as the spelter of that Company is well known throughout the commercial and industrial world as the purest in existence, it

follows that these oxides are completely free from any extraneous substance, differing essentially, in this respect, from oxides made directly from impure ores, such as Franklinite, blende, silicate, &c.

How to test the Dry Oxide.

Take a half pint tumbler of pure water, throw in a teaspoonful of the oxide, and thirty drops of sulphuric acid, and stir up the mixture; if the oxide be totally dissolved and the water remain clear, the oxide of zinc is pure; if any sediment, however small, remain, or if the water become, after a short time, milky or clouded, then the oxide has been adulterated.

How to test the Ground Paint.

Take a small portion of the paint, calcine the same by heat so as to cause its moisture to evaporate, pulverize this calcined paint, and submit the powder thus obtained to the above-mentioned test.

If the paint has been already laid on, scrape off a small quantity, calcine it as before said, and submit it to the same test. In every case the result will justify the same conclusion.

The V. M. Company will, on application at the office of the General Agent, furnish a small tablet, the surface of one side of which is painted half with zinc, and half with white lead. Attached to it is a small tube containing hydrosulphate of soda, in powder. If a portion of said powder is spread on each of the paints, and moistened with a few drops of water, the zinc will remain unchanged, whilst the lead will turn black.

How to detect the presence of Lead.

The admixture of lead paint, lead dryer, or litharge, with zinc paint, would deprive it of some of its principal qualities—namely, of hardness and durability of color—it will readily be ascertained whether such has been the case by the following simple test:

Touch the paint with hydrosulphate of ammonia; if produced from the pure oxide of zinc it will remain unstained; if any of the above admixtures have been used, the spot touched will become black or brown.

How to detect whether Oxides are Damp.

Take a tablespoonful of the oxide and place it upon an iron plate, heated rather above the temperature of boiling water—viz., so hot, that water thrown upon it shall immediately evaporate—hold over the oxide on this heated plate a piece of common glass; if the oxide is damp, the moisture driven from it by the heat will condense upon the glass, and in that case the oxide would have to be dried in an oven before grinding. It is important, therefore, that oxide of zinc should be kept always in perfectly dry stores.

Advantages of White Zinc over White Lead.

They consist mainly in perfect security from the usually unhealthy effects of white lead paint, in greater economy, and in permanency of color; the proofs of which rest upon numerous certificates and affidavits by public functionaries, architects, surveyors, engineers and private individuals, which are not given here for want of room.

Innocuousness.

In its manufacture from plate spelter, and in the various stages of its preparation and use as a paint, oxide of zinc is completely innocuous, and produces none of the physical accidents to which the white lead manufacturer and painter are subject, viz., paralysis, painter's cholic, and frequently death from the recurrence of those diseases; the same accidents not unfrequently affecting the occupants of recently painted dwellings. The advantage, in this respect, of zinc paint, has induced the French government to enforce its use for all public works and government contracts.

All apartments, however confined, may be painted with zinc without disturbing the inmates, who may rely on perfect safety from any bad effects

upon their health; the only inconvenience felt is the usual smell of turpentine, and that in a less degree and for a shorter time than with other paints.

Economy.

The saving produced by the use of white zinc instead of white lead, may be considered as equivalent to 25 per cent.

This economy is derived,

1st. From the circumstance that zinc being a much lighter body than lead, and absorbing a greater proportion of oil in the grinding and mixing, a given quantity of zinc oxide will spread over a more extended surface, than would a similar quantity of white lead, and cover as well, if properly used.

2d. From the far greater durability of the work done with zinc. A house painted entirely with the pure V. M. zinc paint, properly mixed and laid on, and regularly washed every year, with cold water, with which a small quantity of finely powdered pumice-stone has been mixed, will look as fresh for several years, after each successive washing, as if newly painted. (N. B. Soap-suds or potash, should not be used for washing zinc paint.)

The following tables, showing the results of various experiments made in 1850 at the Toulon navy yard in France, are given in support of the above; the original calculation of French weights and measures is retained, it being easy to convert them into the English, if required, taking the following ratio:

1 Metre superficies — 1·200 yd. superf.
1 Kilogramme — 2·205 lbs.

Surfaces covered by 1 kil. of Zinc and Lead Paints respectively.

	1st Coat.		2d Coat.		3d Coat.	
	Zinc.	Lead.	Zinc.	Lead.	Zinc.	Lead.
	Metrs.	Metrs.	Metrs.	Metrs.	Metrs.	Metrs.
On pitch or white pine, new	8.70	7.00	11.80	9.80	11.80	9.20
On " " after scraping the old paint	4.90	4.40	10.50	7.30	10.50	7.80
On oak " " "	5.20	4.70	.. ..	.. ..	.. ..	.. ..
On iron " " "	8.70	6.00	.. ..	.. ..	.. ..	.. ..
On sheet iron, painted the year previously with white lead	5.40	4.60	.. ..	.. ..	.. ..	.. ..

Quantity of Zinc or Lead Paint required to cover 1 metre superficial.

	1st Coat.		2d Coat.		3d Coat.	
	Zinc.	Lead.	Zinc.	Lead.	Zinc.	Lead.
	Kil.	Kil.	Kil.	Kil.	Kil.	Kil.
On pitch or white pine, new	0.1150	0.1429	0.0847	0.1075	0.0847	0.1075
On " " after scraping the old paint	0.2060	0.2270	0.0952	0.1370	0.0925	0.1870
On oak " " "	0.1923	0.2128	.. ..	.. ..	.. ..	.. ..
On iron " " "	0.1150	0.1666	.. ..	.. ..	.. ..	.. ..
On sheet iron, painted the year previously with white lead	0.1852	0.2178	.. ..	.. ..	.. ..	.. ..

Permanency of Color.

The permanency of color in zinc paint is very great, and none of the causes which generally destroy other paints, will affect it.

Indeed experience has proved that the exhalations and the mephitic air, engendered in and emanating from hospitals, prisons, factories, "abattoirs," theatres, water closets, stables, cesspools, ships' holds, and confined and badly ventilated localities, have never been found in the slightest degree to affect the color and durability of good zinc paint.

In regard to the more delicate branch of portrait painting, &c., the use of snow-white oxide of zinc, as a matter of course, tends greatly to preserve the purity of colors against any action of the atmosphere.

Various Uses of Zinc Paint.—For Vessels.

In the year 1850, a committee appointed by the French *Ministre de la Marine*, reported favorably on various experiments made of zinc paint on vessels of the French navy; the results detailed in that report have been fully confirmed by experience, and it is a fact beyond doubt now that zinc paint is the pigment best suited to resist the action of an atmosphere loaded with saline particles or with gases emanating from bilge water, and cargoes of salt, sugar, molasses, salted provisions, fruit, live stock, hides, guano, &c.

For Imitation Stucco, Slates, &c.

This paint embodies itself so completely with oil, and becomes so hard, that it can be polished like stucco. A process has been discovered for using it as a water-proof cement, and also for obtaining smooth, hard and light tablets of all sizes and colors, answering all the purposes of school and office slates. Canvas for portrait painting, prepared with white zinc, has an advantage over all others, namely, that of not being acted upon by metallic colors and dampness.

Practical Instructions—Choice of a Paint Oil.

Several kinds of oil may be used for mixing with oxide of zinc, viz., poppy, walnut, hempseed, linseed, and even fish oil.

Of these, hempseed oil is the best, and dries the quickest; but it is seldom used on account of its scarcity.

Poppy oil is very white and is adapted for inside work; it requires a great proportion of dryer.

Walnut oil being subject to thicken, ought to be kept from heat and light in closed glass vessels; its use is limited on account of that natural defect.

Fish oil ought to be entirely rejected on the score of its intolerable smell, its tenacity of moisture, and its almost certainty of turning yellow.

Linseed oil is thicker, and dries better than any other except that of hempseed: the price is moderate, and it is in every respect the best to mix with oxide of zinc.

Purifying and Bleaching Linseed Oil.

The process of purifying and bleaching this oil deserves to be briefly described here.

An oblong box is made about two feet deep, of plates of thick glass, fitted together, so as to be impermeable, by means of lead sash bars and cement. This box is set up in a place exposed to the light and the rays of the sun; it is filled half with oil and half with pure water, and covered with a glass cover; the contents are stirred up and mixed together from time to time during eight or ten weeks, after which the oil will be found entirely pure, and may be drawn off with a siphon.

By this process the albumen of the oil is separated from it by the contact with the water, and settles down to the bottom of the box. The bleaching is the effect of light.

Any other process, and chiefly the use of acids, is injurious to the oil.

Grinding in Oil.

The grinding of white zinc in oil is, in the main, done by the same means as that of white lead. It may, however, be remarked, that great improvements have lately been made in the old machinery. In France and England sets of three horizontal marble rollers are employed; in America, mills of two burr stones, the upper one of which is balanced on the same principle as a ship's compass, and the lower one only revolves. Both systems give satisfactory results.

The proportion of oil to zinc varies between 12 and 25 parts of oil to 88 and 75 parts of zinc, according to the greater or lesser power and perfection of the apparatus.

One of the advantages of white zinc over white lead, is, that while the latter must always go through the mill, the grinding of zinc can be done on a marble tablet, in the usual way, with a small additional proportion of oil.

In case of need, even simple emersion and stirring, will be sufficient.

Whatever may be the mixing process, no water should be used, as this would constitute the two-fold imposition of increasing the weight, and impairing the quality.

For properly using Zinc Paint.

The use of zinc paint is less laborious than that of white lead, inasmuch as, 1st, the former is lighter and requires less pressure; 2d, a day's work will not prostrate the energies of the painter, as it is well known to do through the use of white lead, daily examples of which are unhappily but too evident to require being cited.

The work is to be prepared precisely as for lead colors. Sizing, knotting, and priming, in similar manner, except that the priming must be done with zinc paint, tinted, if required, with any coloring matter in which lead does not enter, and the work must be stopped with zinc putty before laying on the second coat.

Zinc paint, no more than lead paint, should be used immediately after being ground. It is considerably improved by being kept for a year, more or less, after grinding. The dark gray paint alone, being liable to harden, should be used whilst fresh.

Old white lead painting must be scraped off clean previous to putting on the zinc paint. To save labor, washing and scouring the same with water and potash, or pumice stone, will suffice.

A coat of hydrofuge gray or white paint over the lead paint, and to serve as grounding for the zinc, is also most effectual, and entirely precludes the lead from affecting the durability of color of the new paint, besides effectually securing the object against damp.

Dryers.

No lead dryers should ever be made use of for zinc paint.

There are two kinds of zinc dryers; one is prepared by boiling peroxide of Manganese in pure linseed oil, in the proportion of 1 pound of Manganese to 1 gallon of oil; the other invented and exclusively manufactured by the V. M. Company, is in the shape of an impalpable and pure white powder, similar to white oxide of zinc.

Of the manganesed oil, from 1 to 6 per cent., and of the dryer in powder, 1 or 1½ per cent. should be mixed with the zinc paint in thinning.

Brushes.

It is deemed necessary here to urge the adoption by painters of proper brushes, in order to produce unobjectionable work. The brushes to be used with zinc paint, should be made of white, long and fine bristles, thickly and closely set, and the finishing brush should be flat with very fine points, in order to produce a perfectly smooth surface and even tint. The frequent cleansing of the brushes in spirits of turpentine, cannot be too strongly recommended.

Old or nearly worn-out brushes, as also such in which horse hair or whalebone has been mixed with the bristles, should be rejected.

Mixing Proportions.

Zinc paint, as it comes from the mill, is composed of—

Oxide	75 parts.
Oil	25 "
	100 "

To prepare it for the specific purposes for which it may be wanted, it must be diluted with oil, spirits of turpentine, or varnish, in quantities varying according to the work to be done.

FOR BRILLIANT WHITE.

1st coat	Spirit of turpentine.
The others	Linseed oil.

FOR DEAD WHITE.

1st, 3d and 4th coats	Spirit of turpentine.
2d	Spirit and a little oil.

FOR PAINTING ON PLASTER OR CEMENT (NEW.)

1st coat.	Linseed oil	43 parts.
	Turpentine	21 "
2d coat: Flat or Graining.	Linseed oil	13 parts.
	Turpentine	11 "
3d coat: Flat—	Turpentine only	15 parts.
Brilliant or Graining.	Linseed	13 "
	Turpentine	11 "

PAINTING ON OAK (OLD OR GREEN.)

1st coat.	Linseed oil	5 parts.
	Turpentine	13 "
2d coat.	Linseed oil	7 parts.
	Turpentine	11 "

3d coat: same proportions as second.

PAINTING ON DEAL (NEW.)

1st coat.	Linseed oil	11 parts.
	Turpentine	13 "
2d coat.	Linseed oil	7 parts.
	Turpentine	11 "

3d coat: same proportions as second.

REPAINTING OLD WORK.

1st, and 2d coats and Gray colors,	Linseed oil	7 parts.
	Turpentine	11 "
Graining,	Linseed oil	12 parts.
ditto.	Turpentine	13 "

PAINTING ON IRON.

1st coat—	Turpentine only	17 parts.
2d coat.	Linseed oil	8 parts.
	Turpentine	11 "
3d coat—	Turpentine only	16 parts.

By adhering to the above proportions and to the foregoing advice, painters will find zinc paint to give such satisfactory results, that there is no doubt they will ultimately prefer it to any other.

When the paint is to be used soon after grinding, the oxide may be ground with 20 parts of oil instead of 25, thus:

Oxide	80 parts.
Linseed oil	20 "
	100 "

From the above stated proportions in mixing for use, the painter will find that the paint for 2d and 3d coats will, in the paint pot, be about the consistency of thick cream, which is the proper one. The light nature of the oxide, and the greater fluency given to the paint by the proportions of turpentine, make it spread under the brush with great facility, covering at the same time perfectly well.

It is advisable to keep white zinc paint under oil, rather than under water.

Dark gray ground paint should not be kept too long, and never otherwise than under oil, as it is liable to harden.

(To be continued.)

QUARRIES AND CLAYS.

ON HUTCHISON'S PROCESS FOR INDURATING AND RENDERING IMPERVIOUS TO MOISTURE SANDSTONE AND OTHER POROUS STONES, PLASTER OF PARIS, &C.*

Some time ago, when a French inventor, M. Rochas, was seeking to introduce his process for silicatising soft stone, and even for staying the progress of decay in stone buildings already erected, we spoke of Mr. William Hutchinson's patent for indurating and rendering inpervious to moisture soft sandstone and other porous stones, plaster of paris, and various absorbent materials. Since that time a company has been formed to carry out the patent, and we have taken an opportunity which was offered us to inspect the works, and to examine some of the examples of the indurated stone which have been longest exposed to wear and the weather. The works at present in operation are at King's Quarry, close to Tunbridge Wells, which is held under a lease from the Earl of Abergavenny, and furnishes a stone so soft and friable that it may be reduced to powder with very little difficulty. The sandstone, grits, &c., are affected by the weather, either by the mechanical effects of moisture admitted into the interstices, or through the decomposition of the matter cementing the particles together; and Mr. Hutchison's patent, it will be seen, fights against both these operations. The process is extremely simple; perhaps we ought to say the processes; at all events, two modes are employed, the one changing but slightly the color of the stone, the other rendering it much darker, in fact nearly black. The latter is much the cheaper process, and is performed with ordinary gas tar, purified, and to some extent changed by successive boilings. In a large tank of this, over a furnace, the pieces of stone are placed, and remain on an average about six hours. In some pieces that we broke, the tar had penetrated three or four inches on all sides, and in others had permeated the whole mass. After the stone has been taken out of the tank and cooled, the surface is cleaned off. To preserve a light color the stone is dipped into boiling resin instead of tar.

By the process the stone is made very hard, its specific gravity is considerably increased, and it is rendered non-absorbent. A three-inch cube of stone prepared by the first described mode, after being steeped in water for twelve hours, had gained no appreciable increase of weight; while a similar cube of the stone, in its natural state, absorbed two ounces and a half of water. The stone of which we are speaking, is altogether useless in its natural state. Searching for specimens of the prepared material which had been exposed for some time, we found a tombstone that had been out for three years, whereof the arrises were perfectly sharp and untouched; a *grindstone* which had been in use four years, and some pavement lozenges of the black and white alternately, that had been laid the same number of years, and were very sound. Being impervious, it serves to keep down the damp. Copings, sinks, horse-troughs, appeared to have stood well. For use in hydraulic works, sea walls, dock-basins, tanks, &c., it would appear to have strong claims. We should add that the invention is not confined to stone in a solid state; pounded sandstone or other material may be mixed with loam, and rendered hard and impervious by introduction to the tank. We found the workmen, in this way, manufacturing stable-pitching, out of material otherwise useless.

* From the London Builder, No. 618.

The *Sussex Advertiser* looks to the invention hopefully, as promising great results as regards the district, which has at present, "so to speak, no special manufacture, no distinctive 'staple' of industrial trade." "The important merit," says the writer, "in Mr. Hutchison's invention is the striking fact, that out of two materials—each comparatively valueless in itself, viz., sandstone and gas tar—he produces by direct amalgamation, under certain processes, a most valuable and highly useful commodity. It has been held that that man is a benefactor to his country, who can make two blades of grass grow where only one grew before; Mr. Hutchison has done more; he has taught us to convert two bodies, nearly useless in themselves, into a material whose uses can scarcely be circumscribed; while, be it added, this material can be furnished at a rate little beyond, we believe, half the usual cost of ordinary stone.

Sir Roderick Murchison, the well-known eminent geologist, has expressed an unqualified opinion in favor of the process. In a letter to the patentee, Sir Roderick says: "Believing that your method of indurating the soft sandstone of this neighborhood, and of rendering a material which is so easily worked as *durable as the hardest rock*, and quite impenetrable to moisture, I sincerely wish you may have that success to which you are justly entitled. It is manifest that, in a climate like this, a cheap building stone, which *throws off wet and never can absorb it*, must be highly valuable, not only in the construction of houses, but in all hydraulic, paving and monumental work." He goes on further to say: "When I further know that every sort of decoration can be chiselled out at the very slightest expense, and with great rapidity, and that in a few hours the material can be rendered *an indestructible rock, with edges that can only be destroyed by violence, and never can be affected by weather*, I conceive that your patent only requires to be known in order to be generally appreciated." We do not go as far as this: we may not pretend to say that the stone, as thus prepared, "*never can* be affected by weather." Time must settle that question. But it certainly does seem clear to us that in many localities, and for many purposes, the process we have been describing may be employed with very great advantage to the public, and much profit to the owners of the patent.

There are two architects, we observe, connected with the company, namely, Mr. N. E. Stevens, of Tunbridge Wells, (who, by the way, has built some picturesque houses there and in the neighborhood,) and Mr. Edward Roberts, of London. We sincerely hope the undertaking may prove successful.

MISCELLANIES.

SEPARATING IMPURITIES FROM MINERALS.

Mr. Joseph Gibbs, of Abingdon-street, Westminster, has recently patented some improvements in the methods of separating impurities from coal and other minerals, in cases where such impurities are of greater specific gravity than the minerals themselves. The apparatus consists of a washing-machine, in which a flow of an upward current of water through a receiving vessel is employed to carry over the coals, or other light mineral substances; while the heavy impurities sink to the bottom of the vessel, and are removed by another current of water directed down upon them, through a sluice open for the purpose. The material is to be first ground into a rough powder, and then sifted into parcels, containing particles as nearly of equal size as possible.

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Art. I.—MINES AND MINING IN CALIFORNIA.*—By Prof. John B. Trask.

PLACER MINING.

This branch of industry in this State has been prosecuted with much vigor during the past year, and many new discoveries of placer deposits have been developed within the past season. Those who have engaged in the heavier operations of this department, have carried their workings to an extent heretofore unparalleled in the history of mining in this State, the details of which will be noticed more at length in the following pages.

In the present article I shall review, briefly, the history of this branch of industry, and adduce such testimony of their probable continuance as has fallen under my observation, and such as will be found supported by facts alone.

There has been much discussion abroad relative to the probable continuance of the placer deposits of California, and attending this discussion a manifest disposition among Atlantic writers to underrate the capacities of the State for the production of gold. So far as the personal interests of such individuals are involved in this question, we have nothing to do; but when the publication of such articles are carried to an extent that a public injury is sustained upon our shores as a consequence, then it becomes a duty we owe to ourselves to speak in defence of the State of our adoption, and place the question before our friends and relatives abroad upon that basis upon which alone it can stand.

We shall, therefore, confine ourselves to facts, as developed within the past year and the year preceding, which will define, to some extent, the areas of the placer ranges on the western slope of the mountains; and it is to be hoped that they may prove sufficient to convince such as may be seriously affected with melancholy for our future fate in this particular, that they are in no danger of sinking deeper into the slough of that insolvency which their over-heated imaginations have prepared, from any failure,

* Report on the Geology of the Coast Mountains, and middle and northern mining district, made to the Legislature of California—Session 1855.

on the part of this State, to produce even an increase on her past annual exports. The commercial circles of the East have been saved from bankruptcy by our exports, and we shall still continue to exercise the same paternal care over their interests as formerly, provided they will relieve us from accepting the entire produce east of the Rocky Mountains. Since 1849, we have had but a reiteration, from year to year, of this doleful prognostic, and this in the face of a continual advance on each annual aggregate exported from our shores, until now the public mind has become less sensitive to the dismal moan, which greets the eye or ear from some portion of the Atlantic board on the arrival of almost every mail.

The failure of an arrival of the accustomed number of millions per month to the Atlantic cities, is found to create a feverish panic among our distant friends, which is to be regretted, as an injustice to the people of this State usually follows such a contingency, from some portion of the Atlantic board. This arises from the fact, that parties abroad do not possess the local information of those causes which are productive of such a failure, neither could they properly appreciate the same, were it in their possession.

The only regret to which we must submit in this matter is that, as a State, we have exported too much; but the prospect is that in the future we shall export much less gold than formerly. The report of the Controller of State for this year shadows forth the long wished for advent of confidence in capital investments for home improvements, and is a true exhibit of our resources; showing that, notwithstanding, we have an increase of one million above our exports of the preceding year, yet we still have added to our home capital, permanently invested, fourteen millions, within the same period.

In my report of last year, it was stated that the placer ranges were at that time known to extend nearly to the summit ridge of the mountains; but this year it has been ascertained that they pass beyond the ridge, and are now found on the eastern declivity, having nearly the same altitude as those occurring on the opposite side. Within the past season, many of these deposits have been examined, and thus far are found to be equally productive with those of similar ranges to the west, and, with a favorable season ensuing, they will be largely occupied.

This increases the breadth of the placers, in the more elevated districts, about nine miles, and the length between twenty-five and twenty-seven miles, on a line parallel with the trend of the mountains. This additional field is what may be denominated "dry diggings." Still they will prove available only during the summer season and early part of autumn, from their altitude and local position.

Since my last report, I have been enabled to trace the "Eastern Blue Range," for a distance of thirty miles south of the point

at which it was left last year, and, as far as examined, it possesses most of the general characters that were mentioned in relation to this district at that time. Its line may be defined to a considerable degree of accuracy by the following localities:

South of the middle branch of the American River, it is found at what is known as Cement Hill, being part of the same range of the Mameluke Hill, a short distance south of the former. Extending in a southerly direction from the vicinity of Georgetown, it is next met with at White Rock, some sixteen miles distant, and about three miles east of Placerville. In this section of country, the outliers of the range are distinctly seen, forming level ridges for long distances, the latter surrounding small basins or forming the flanks of broad ravines, similar to that known as Coon Hollow, and other adjacent localities. From Placerville it extends in a southerly course for eight miles, and it is again met with some three miles east of the town of Ringold, forming a flat table, of small extent, on the side of a hill facing to the south-west. From this locality it assumes a more south-east course, and is again seen on the sides of the hills, forming the banks of Indian Creek, in the county of El Dorado. This is the most southern limit to which these placers have been traced with any degree of certainty.

A course a little east of south would bring this line of deposits in the vicinity of the town of Volcano, in the county of Amador, but it is yet quite uncertain whether this mining town is absolutely upon this range of placers, or whether it passes to the east of the high ridge back of this locality. From what observations I was enabled to make at Mokelumne Hill, and also south of this point, I am inclined to the belief that if it passes through this section of the State, it will be found to the east of these latter towns, at distances within eight or twelve miles. The high table ridge to the east of Chilian Gulch possesses many of the external features which mark this range in other parts of the State; but the conglomerate beds found adjacent to this section indicate this to be of much more recent origin than the placers under consideration. The absence of any fossil remains from this district renders it difficult to form any conclusion that would be satisfactory on this point; it will therefore be omitted until such times as farther investigation may be had upon this immediate vicinity.

We will now turn to the more particular consideration of the placer, as far as known, and examine its capacities for production, with other characteristics that mark it in its course.

The line of the deposit has now been traced distinctly for a distance of one hundred and thirty-six miles, in an almost continuous line, and upon it are now located many of the most valuable mining districts of the State, on which the heavier investments of capital have been made for its successful workings. From the nature of the ground and its location, being very remote from the plains, and in many cases difficult of access from its elevation even

above the adjacent country, it necessarily has required a much greater outlay of capital to develope its treasures than any of the districts lying to the west of it, and improved as mining ground, and thus far has yielded a proportionably greater amount of gold.

So far as these districts have been opened, they have fully sustained the character which they have heretofore acquired, and particularly noticed in the preceding report, viz., *that in no instance, up to the present time, has this placer failed to reimburse the money expended in opening the ground, reaching the lead and returning a handsome profit to the adventurer.* This cannot be said of any other range of placers in this State.

Up to the month of November last, there had not been an abandoned claim upon the range where the works had been conducted with the view of reaching the lower lodes of the range, and no failure has occurred in striking the lode where the adits have been driven at any sufficiently low point.

From these facts alone, it will be seen that the placer mining is not altogether a game of chance when conducted with skill, well-directed and practical judgment, and it teaches, also, another valuable lesson, which is, that segregated labor and capital is not sufficient to cope with the heavier branches of placer mining, neither is it as profitable in its results as when otherwise and judiciously directed. This branch of industry in this State has taken that place at the present time, which strictly entitles it to the appellation of a science, and he that would fully appreciate it should witness it. Placer mining to California is what coal mining is to Pennsylvania, and the great coal districts east of the Rocky Mountains, and we are fast approximating that day when its subterranean operations will equal, and in many instances exceed the latter. Should there be those who foster doubt on this point, and doubtless there are many such abroad, I would respectfully suggest to such, a visit to the upper portions of the counties of Placer and El Dorado, with those of Amador and Calaveras on the south, and those of Nevada and Sierra on the north. In these counties they will find an ample field of operations, on which they will find but little difficulty in forming an opinion of the character and extent of the workings beneath the surface, and the means employed to consummate the end. They will find the engineer with his levels as carefully adjusted and applied as though his survey was instituted for the levelling of a rail track, and the necessities of accuracy in the selection of the most feasible point to tap the heart of the mountain is equally as great in the one case as in the other.

The placer miner of the present day in this section of the State, estimates the costs of the operation on which he is about to enter with all that care and attention that would be bestowed upon any other enterprise where the sum of ten to thirty thousand dollars is the sum to be invested, and where his interests are involved

to that extent. It is not uncommon to find amounts equal to the above, invested in our larger operations now in progress of working, and a few instances among many, may serve to illustrate the fact. I will mention but two or three in connection with this part of our subject.

The cost of opening the Mameluke Hill, near Georgetown, by the parties interested, exceeded forty thousand dollars, while the receipts for the same during the period of little more than one year, have exceeded five hundred thousand. Another case is that of Jones's Hill, the opening of which has already risen above thirty-four thousand dollars, the receipts being above two hundred and eighty-four thousand dollars; and still another in the county of Nevada (Laird's Hill), the expense of opening was nearly forty thousand dollars, while the receipts from the latter in June last, had reached the sum of one hundred and fifty thousand—the resources of either are as yet in any thing but an exhausted condition. The above are mentioned only for the purpose of conveying a better idea of the expenses and profits of what is denominated deep mining, in this State, and the localities named form but a small proportion to the aggregate of similar workings.

In the counties of Nevada, Sierra, Placer, El Dorado, Amador and Calaveras, there are scores of adits and other workings of smaller dimensions, which have already cost sums varying in amount from ten thousand dollars upward to the figures given above, and from which proportional profits have been derived. The mining districts abound with evidences of wealth like those above, and they possess equally as strong evidences of permanency of character, and it would be no difficult matter for the incredulous to banish his incredulity, if he will but take the trouble to investigate the facts which nature and individual enterprise have placed before him.

An idea of the necessary expenses that must be incurred in conducting these branches of placer mining, can be obtained only by an examination of the adits which have been driven in prosecuting these labors. There are but few which are less than three hundred feet in length, and many that range from ten to twelve hundred feet, and of a size sufficient to use a horse within for the purpose of delivering the earth to be washed at the sluice or the attle at the end of the tramroad. These adits are driven in some cases hundreds of feet through solid rocks, and when thus conducted they often penetrate the very centre of a mountain, or as in the case of the high ridge south of Placerville, they have not only reached the centre, but have passed entirely through the ridge.

In other parts of the State, the heavier placer operations are conducted in a different manner. In place of the adit, a broad ditch is carried through the hill, and the entire hills removed to their base by hydraulic washings. This system of working, as

conducted in this State at present, will compare very favorably in magnitude with any system of mining operations of the Atlantic States, or even in many parts of the older continent, and from the success which has thus far attended it, it bids fair to advance much beyond the limits to which it is now confined. Five years have elapsed since the mines of this State were worked to any considerable extent. The area that is now known to contain valuable deposits of gold, is believed to be at least six times greater than that which was developed during the years of 1848 and 1849, while the number of miners actually engaged in the extraction of gold is less than those of 1852, yet the export of the year last past exceeds by nine millions the total exports of the former year. Under these circumstances, it is rather a forced conclusion to arrive at, that the mines of the States are in any way likely to recede from their former productions; and we would suggest to our friends abroad, that it is time they had divested themselves of the idea too long prevalent, that our placers will soon become exhausted, or that the workings consist in mere surface scratching, without depth or probable continuance. We have evidences that should prove satisfactory to reasonable beings, that they are something more than an ephemeral show, as all known facts in this State are opposed to that position, and they are abundant for two hundred miles of the length of the eastern mountain chain.

In order to convey a better idea of the mining districts, they will be divided into three distinct ranges, denominated the Upper or Eastern Range, the Middle Placers, and the Valley Mines. This has now become necessary from the fact that the characteristics of these districts are as distinctly marked as are the northern, middle, and southern portions of the State. It separates also three evidently distinct periods of the geological history of this part of the continent, in which marked changes are apparent upon the surfaces that had emerged above the ocean during that epoch.

EASTERN RANGE.

This district extends from near the summit ridge of the mountains to within about twenty-five miles of the edge of the plains. It maintains a very uniform breadth of about twenty miles, and a length of one hundred and thirty, as far as known. It covers an area equal to about three thousand square miles, a large proportion of which is available as mining grounds.

In this district is situated the major part of what is known as the "dry diggings," which includes the towns of Forest City on the north, and Placerville on the south. At the present time there is but a comparatively small portion of this district occupied and improved. Admitting that of the area included within the lines of this district, but one third of the same may be considered as containing placer deposits, we shall have for the immediately

available purposes of mining an area equal to one thousand square miles.

A glance at the entire area which is now in actual occupancy on this range, and employed as mines in active operation, will convince those acquainted with the district that but a very small fraction of the available territory is as yet opened or in any manner improved. It is estimated that twenty square miles will cover that area, and even this may be considered a large figure for the grounds so improved; amounting to two per cent. only, of the lowest aggregate that can be placed upon the unoccupied district of the range. It is doubtful whether there are men enough in this State (aside from those required for the transaction of other departments of business), to occupy and improve even one half of the available mining lands that lie in the four middle mining counties of the State, which at the present time are untouched; for it is pretty well ascertained that the absolute amount of ground in fourteen of the mining counties, now under improvement for those purposes, does not exceed five hundred square miles. The amount of territory in each county which is unoccupied forms a heavy aggregate against the other.

Of the eastern range of placers there are wide districts intervening between the settlements on the range, and an approximate idea may be obtained of the extent of these placers, by citing districts that are well known, which will convey at the same time a better conception of the proportions occupied and the reverse.

The counties of Placer and El Dorado are fair examples of this district; they lie adjoining each other, and are situated nearly in the middle of the State, and of the range. The deep workings of the above counties extend north and south for a distance (air line) of thirty-three miles, the north fork of the American being one boundary, and the mountains and its tributaries being the other on the south; the breadth included in the above line and extending east and west is about fourteen miles. The mining towns within this district are Iowa Hill, Michigan Bluffs, Georgetown, Spanish Flat, Placerville, and other smaller settlements situated between the above and to the east of the line as given.

The area of the eastern range in these counties alone, amounts to four hundred and sixty-two miles, nearly one half of the aggregate amount for the State, as belonging to this particular range of deposits; and when we recollect that there are four additional counties through which their placers are found, the estimate of one thousand square miles will not be considered as excessive.

To those who are acquainted with the section alluded to, I have no hesitancy of submitting the above figures, for there is no object to be attained in presenting a fancy sketch of our available resources. We may draw upon facts for many years to come in regard to matters of this character, for the mining districts are possessed of an ample fund for that purpose.

It must not be understood that the "deep diggings" of this district are the only resources obtainable, or that they constitute the only deposits of gold in the range, for it is far otherwise. The entire surfaces of this range are productive of this metal; it was from the surface washings of portions belonging to this district of the State that a large proportion of the gold was obtained during the earlier periods of mining. These placers still continue to yield profitable returns for labor, though long since they were among the old workings which were considered exhausted. The returns from these old placers at the present time are attributable to the improved methods of mining that have been introduced subsequent to their first becoming abandoned, and the greater care which is now bestowed in washing the earth.

The placer miner of the present day will not exhaust the same quantity of ground that he would have done in 1850 or 1851, and at the same time obtain an equal and, in some instances, a greater amount of gold from one of these exhausted placers. We may, therefore, regard the surface deposits of these sections as prolific sources of wealth for years to come. This conclusion is based on the facts which past experiment has demonstrated, and which are acknowledged throughout the State by those who have given any attention to the subject.

In selecting the counties of Placer and El Dorado as illustrative of the character of the eastern range of deposits, I would not be understood as expressing any preferences, of productive capacity or of a better defined range of these deposits; they were selected from the fact that they held a more central position in relation to the above than for any other purpose, and they do not, to my knowledge, afford any better illustration of the characteristics of this district, than the counties of Sierra, on the north, or that of Amador or Calaveras, on the south; in fact, this range is much better exemplified in the county of Sierra than at any point south of the latter.

MIDDLE PLACERS.

By this term is expressed that range of country which is situated at an average distance of about twenty miles from the line of the higher foothills, or having its western border within about four miles of the edge of the plains, comprising a district of country of twenty miles in width and three hundred in length, having a trend parallel with that of the mountain chain in which it is situated; it covers an area equal to about six thousand square miles.

On this range is situated what is denominated the surface workings, although there are some instances in which the deposits of drift containing gold lie nearly as deep as those alluded to in the preceding article. This, however, is not the general fact relative to these districts, and the labor and expense of extracting the

metal, consequently, is not as heavy. The ordinary depth of the placer drift in this district ranges between twelve and forty feet; it is composed of a more heterogeneous collection of stones than the deposits of the higher range; in the latter the pebbles and boulders have but few varieties, while those of the middle placers are composed of many; so much so is this the case, that it is often difficult to distinguish what rocks predominate.

The "bed rock" of these districts is composed mostly of slates elevated to high angles of inclination, or the same rocks changed by heat, in some cases to that extent as nearly to obliterate their former structure; their transition has been so complete that they have assumed the character of true porphyries; this must have occurred prior to the deposition of the drift, as these deposits bear no marks of igneous action since they were deposited. In some localities the drift beds are found resting upon the granite direct, the latter rock often presenting evident marks of the action of water.

In examining the gravel from this district, we will often find the stones which are peculiar to the eastern range mingled with those of more recent date, and which are often found in closer proximity *in situ;* with the above is also found more or less of the smaller gold of the upper districts commingled with that which is incident to the middle sections of the State.

These facts naturally lead us to the conclusion that at the period in which the gravel drift of the middle placers were deposited that the country to the east was subjected to the action of floods which must have been somewhat violent in their character. I am not prepared to say at this time, that the deposits of this district of the State, were formed during the period of the NORTHERN DRIFT, for there are some features wanting to establish that point conclusively. Should the above fact be ultimately established, there are attendant circumstances that will prove the eastern range to have preceded that period, and which has been alluded to in former reports.

The economical value and extent of the middle placers, is the principal object of their notice in this place, and we will therefore direct our attention to that particular point. It is upon this range of country that the greater proportion of the mining community of the State are located, and more particularly upon the central and eastern portions of the same. The cause of this is obvious, for from the nature of the ground to be operated upon, segregated labor is more prosperous, and small companies with limited means can prosecute mining with better success and profit than in the heavier workings of the eastern range of placers. The labor and incidental expenses for facilities in the extraction of gold, are much less and more easily obtained as a general rule than in the former case; hence men who are possessed of limited means usually occupy the middle sections before entering the

field of the more lengthy operations that are conducted in other districts.

This district of the State is but sparsely settled, at the best; and like many other portions of the mineral and agricultural sections, there is but here and there a few scattering cabins or small settlements, often for many miles. The placers that are spread far and wide throughout this section, are scarcely touched, or if so, they are marked by a few small shafts only, which have been sunk by some prospecting miners, in their rambles over the State in search for richer fields than those they left. It is often the case that these shafts have remained for two or three years after they were driven, when they have again become occupied by others, yielding profitable returns for small amounts of labor. It is from these very partial examinations of travelling miners made in preceding years, that some of the most valuable placer deposits have been developed; the hints thus given in the former case have been adopted by those who have subsequently followed, and have thus led to pleasing results.

The introduction of water by artificial canals into regions lying remote from natural streams has had the effect to develope further the fact, that but limited sections exist in this district in which the staple product of the State does not abound. From the above facts we should be led to infer that a much larger population than that at present found in these districts should follow under the circumstances: it should be thus, but there are causes which at present operate to prevent such a result, the principal of which, is the want of a sufficient supply of water to conduct mining operations to that extent which the character of the country requires. The natural supply of this material seldom exceeds four months of the year, in amounts that would be equivalent to subserve the above purposes, in the greater proportion of the mining localities of this range, and this too at that season when labor is nearly suspended from inclemency of the weather. In order therefore that an extensive population should be found upon the unoccupied portions of this part of the mineral district, the introduction of water by artificial means becomes an essential requisite.

An increase of our mining population in any district of the State, has no tendency whatever to excite any fear of the exhaustion of the mines of that locality to which they may chance to wend their way; for it is now admitted that sufficient room for labor abounds in any of the mining settlements, for a much greater number than those who now occupy them. The introduction of water by canals through an unoccupied portion of the State, is as certain to bring in an active population along its line, as the fact that such an agent is known to exist, as it is well known that nearly the entire surface contains a sufficiency to largely pay for labor in its extraction.

So far as the middle placers have been opened, they have thus far proved productive to an eminent degree, and the new placers which had been developed within this range have, as far as known, proved fully equivalent to those which have preceded them, and there is no good reason that can be advanced for the untenable position that has been assumed, that the present theatre of operations is the *finale*, any more than for a similar opinion which was entertained four years since in relation to those localities at that time occupied, and which are still yielding their annual quota nearly the same as before.

VALLEY MINING.

We come now to the consideration of the lower and most western districts in which deposits of gold have been found, and which constitute the third and last in the order of arrangement.

The valley mines are those districts which are situated among the lower foothills of the mountains, and extend westward from thence into the eastern edge of the plains of the San Joaquin and Sacramento to the extent of three to five miles. These mines are distinctly traceable from Chico Creek in the County of Butte on the north, nearly to Snelling's ranch on the Merced River to the south, having a linear distance of about two hundred and fifty miles. The position which they maintain, or whether they exist at any point north of the first-named boundary, and south of Fort Reading on Cow Creek, in the county of Shasta, I am at present unable to state, not having passed over that particular district during the past season. But the opinion may be safely entertained, that they are continued through the latter district, and that the placers of the Upper Sacramento Valley alluded to in the preceding pages of this report are but the northern termini of this belt. The valley mines are situated on what has been spoken of as constituting the higher terraces of the plains, and are composed of alluvial drift mostly, which have been derived from the lower hills adjacent to their borders. The gravel of the lower beds is usually small, and composed of the pebbles found in the conglomerates commingled with the smaller stones which have been conveyed by the agency of water from the approximate portions of the middle districts. The gravel is usually much discolored by the ferruginous materials with which they are intimately commingled, and all the beds containing gold, from the surface to their greatest depth partake in a high degree of the same peculiar characteristic. The deposits are found to extend to depths varying from three to eight feet, and rest on sandstone, slates or clay beds above the latter, and are the most shallow of any of the placer ranges as yet discovered in the State, and at the same time the most easily worked. In my report of 1853, the attention of the Legislature was directed to the peculiarities of this district of the country under the head of mineral resources,

and which will be found on pages 21 and 22, of Assembly, Doc., session 1853. I recur to this subject again at the present time, trusting that this district may attract that attention to which it is entitled, hoping that some measure may be adopted that will have the effect of preventing those collisions which must ultimately ensue between the agriculturists and miners in regard to the occupancy of the lands.

It is incumbent upon me to define, as nearly as possible, the probable extent and local position, both of the agricultural and mineral lands, so far as the same comes within my knowledge; and for this purpose, this subject is again introduced, so that in sectionizing, hereafter, these districts may be distinctly marked, and their boundaries thus known.

It has been generally supposed that the entire valley lands skirting the foot-hills, possessed but limited amounts of the precious metals, and that when such lands containing gold were thus known, the deposits have been regarded as purely accidental. Such is not the case, however, and if it were, the same rule would be equally applicable to every other portion of the mining districts of the State. Since the days when that opinion prevailed, there have been circumstances occurring, at different times, respecting the true characteristics of these lands, which have had a tendency to modify the views then entertained respecting them, to that extent that those views have now become entirely obsolete, and the valley mines are now considered nearly co-extensive with the middle or upper districts, and they probably fall but little short of the latter.

So well defined is the mineral district of the plains, that, at the present time, there are not less than eight water companies who have extended their works to the foot-hills, and three of this number were distributing water four miles beyond the hills, into the plains, during the month of December last. In the central and more northern portions of this range, the extension of these canals is being prosecuted as fast as the nature of attending circumstances will permit, and from what is now in process of being completed beyond the line of the lower mountains, there will not be less than twenty-three of these canals discharging water on the surface of the valley within the current year. In seven of the principal mining counties of the State, there are one hundred and nine companies engaged in the conveyance of water for mining purposes, and with this amount, even, there is not sufficient to supply the demand. We may therefore conclude that the small quantity which twenty-three flumes will convey to the valley mines will not probably amount to over eighteen per cent. of that which will be requisite for their operations.

Should an ample supply of water be furnished to open this entire range of placers, we have not a population sufficient to occupy and improve it, aside from those engaged in similar oc-

cupations in other parts of the State. A large proportion of these mines will, therefore, remain untouched for many years to come, and improved only in isolated portions, where the conveniences of water are easily obtained.

Most of those who are at present engaged in this district, are men who have formerly occupied themselves in the older and mountain districts since 1850, and are, therefore, capable of judging of the comparative value of a placer of this kind, with those of other sections. Their experimental knowledge is, therefore, of some value, as a criterion, to judge of the prospects of these mines, as being remunerative for labor, if no other more conclusive considerations presented themselves.

We will not stand upon the basis of individual opinions alone, in this matter, but will present an outline of the settlements upon this range of country. They will present the best argument of the capacities, progress and development of the mines, from the date of their discovery to the present time, and the character of these valley sections.

The localities situated along the line of these mines are well known in the State, and as a consequence, their comparative products will be easily estimated by those who have even but a slight acquaintance with the mineral products of the country.

Commencing in the county of Butte, the first mining locality is on what is known as Neal's Flat; following a southerly direction to Butte Creek, they are again found at Rich and Reeve's Bars, on that stream, and a few miles further south the mines are occupied in and about the vicinity of Spring Valley, and thence to the banks of the main Feather River; crossing this stream they again occur in the vicinity of Iowa Ranch, nine miles southwest of the town of Bidwell. Following the line of the foot hills to the Honcut Creek, miners are engaged on both sides of this stream, and but twelve miles distant from the town of Veazie.

From the Honcut south, the next placers which are improved are those upon the banks of the Yuba, in the vicinity of Ousley's Bar, being but fourteen miles east of Marysville. There are two mining camps near the edge of the plains between the south banks of the Yuba, before reaching Camp Far West, on Bear River, which is the next locality of any note. From this place to the American River, there are four localities in which these mines have been opened, and which run west of a line cutting through Massachusetts Bar, the lowest on the latter stream.

From the latter locality, we pass through placers three miles from Alder Springs, and in a southerly course from thence to the west of Priarie City. On the Consumnes they are again found at Michigan Flat and Cook's Bar, and following the plains they again occur four miles west of Ione Valley. South of the latter and along the western lines of the county of Calaveras to Jackson Ferry, on the Tuolumne River, and between that stream and the

Merced, there are ten locations, known as mining camps or towns, the inhabitants of which will equal those of some of the more inland districts. The number of settlements on this range, at this time, amounts to thirty-one, several of which have been occupied for the past two years. This fact alone is sufficient to establish its character as a mining district, and it is one also that many hundred thousands in gold has been extracted from during 1854.

I have been thus particular in noting the localities situated upon this range, for the purpose of quieting if possible, some few of those periodic effusions which flow from the over-anxious conservators of the public good both at home and abroad, by exhibiting what may be considered an approximate outline of the area of our mineral resources so far as known, and to contradict plainly by statistical facts, (the bolder enunciation which too often appears in the colums of those who should be possessed of better information) that the mines of this State are in a depreciating condition, to that extent that either confidence or capital investment in either branch, may be considered a hazardous enterprise.

Another reason for the local details respecting the valley mines, as given, is for the purpose of eliciting that attention to the location of lands for agricultural purposes, which the statutes of this State and the United States prescribe in relation thereto, and to define, as near as possible, the western limits to which the mineral lands in all probability extend; and due care in selecting lands for the purposes of agriculture along the eastern borders of these plains will ultimately save much expensive litigation and trouble.

The western limits of the mineral lands are generally well defined, and so distinctly marked, that even the stranger may readily recognize them in passing across them. The following are the characteristics that will designate these grounds, from those in which no gold has as yet been found, and which latter approximate and form, in some few instances, the eastern borders of the plains.

I will here quote from my report of 1853, the original description of this section of the State. I have seen no reason to change the opinion then entertained, but believe that all subsequent events to the present time are fully corroborative of that position.

"This district of country is situated in the lower foot-hills and immediately on the eastern edge of the valley. It maintains a very uniform breadth of about four miles (from the base of the hills), and is almost uninterrupted throughout the valleys adjoining on the foot-hills to the east. A large part of the mining district of the county of Sacramento is a true example of these lands, though the principal range alluded to is situated a short distance west of those points in which mining operations are conducted at the present time."

This district is strongly marked throughout its entire extent, and in passing over it either from the mountains or from the valley to the mineral districts proper, the transition is so marked that it cannot fail to attract the attention of the most careless traveller. It will recur to the mind of almost every person who has passed from the valleys into the interior, that, at the distance of some fourteen miles east of the Sacramento River, he enters very suddenly a district of the plains thickly strewed with small *angular* pebbles of quartz, the belt is scarcely less than two miles in width at any point, and in some places much broader (extending often to four miles). On reching the eastern verge of the plains, the transition is equally marked and sudden as in the first instance; the *angular* pebbles disappear and a few round pebbles mixed with alluvium, replace them for a short distance, when these are immediately succeeded by the outcrop of the slates."

"From what the writer has seen of this district, I feel no hesitancy in saying that it must in a few years become the busy field of active and extensive mining operations, and I think this opinion will meet the concurrence of those persons who are intimately acquainted with the localities, and are engaged in mining operations, at the present time, within the limits prescribed."

"It is not to be understood that this section of country will prove as highly productive in a short space of time as the superficial deposits of the interior sections, nor can it with any degree of propriety be expected, but as a compensatory principle, they will possess the double advantage of being readily accessible, and though yielding a lower, they will render a more continued remuneration for labor and a surer prospect of success."

In quoting the first part of the last paragraph, I would not be understood as entertaining the same opinion at this time, for the development of these places since that day has furnished grounds for change of opinion in that particular, and I take this opportunity to recall it.

Within the past year, where the advantages of water in sufficient quantity existed to conduct operations in mining, these districts have yielded as fair average returns for labor as any district of the State. And though situated so far to the west and into the plains, where we should have expected to have found little else than fine "drift gold," it is proved that in the majority of those localities which have been opened, that metal equally coarse with much found in the more elevated districts has been taken from the valley mines. This fact is sufficient to do away with the idea that the deposits of the plains are merely accidental, as they have been termed; they have evidently been derived in a great measure from the breaking down of the adjacent sedimentary rocks, which contain veins of auriferous quartz, the disintegration of which has furnished the material which we

now find distributed throughout the range, and from that cause we may expect that these placers will prove equally advantageous for operation on an extended scale as many of the more ancient beds of the Sierra Nevada.

The limits of that district, containing gold upon the plains, I should estimate as carrying a line parallel with the foot-hills, and at a distance of four miles west of the latter, and which should be considered mineral lands in the strictest sense in which that term is applied, and they should be subjected to the same jurisdiction that now obtains in the mountain sections. Such lands under our present system of laws are not subject to entry, and the fact is thus mentioned that their position may be better understood.

From the best information obtained from all parts of the State, it is believed that the amount of ground in actual occupancy and under improvement for mining purposes, does not probably exceed four hundred square miles, one fourth of which area may be included in what are known as old placers, and which are still productive. During the year 1852 it was estimated that one hundred thousand men were engaged in the extraction of gold (this is probably a close figure), a much greater number than has been employed since that time, and whose aggregate product for the year amounted to the sum of forty-five millions of dollars. Taking as a basis the returns of the last census, from which we find that the total number of inhabitants in the mining counties for that year amounted to one hundred and forty-three thousand (allowing thirty thousand for El Dorado not returned), sixty per cent. of which number were probably engaged in the actual process of mining, or a total of about eighty-six thousand thus employed for 1853.

This is probably above the actual number employed during 1853 and 1854, as a very large number of those formerly engaged in mining have employed their time, since 1852, in agricultural pursuits. These estimates may be considered approximations only, but taking the highest possible figure that can be given for those employed for the years 1853 and 1854 (eighty thousand), the following proportional results for labor will be found; the actual working time, in this branch of employment, in this State, being about eight months of the year. The figures below comprise those only which have appeared in manifests, with the exception of those of 1854, in which the deposits at the Mint for coinage and bars during the months of November and December are included with that known to have remained on deposit in different parts of the State, and which was the product of the year last past. The two latter sums make up an aggregate of little more than eleven millions, which, with the exports of 1854, amounts to the sum of sixty-one millions that is known as the product for that year:

TABLE OF EXPORTS, PRODUCT, AND AVERAGE WAGES.

	Exports & Product.	Mines.	Average Per Annum.
1852, - - - -	$45,000,000	100,000	$450
1853, - - - - -	56,000,000	86,000	670
1854, - - - - -	61,000,000	86,000	700

The above is certainly a much better remuneration for labor than can be found in any other State of the Union, and is fully corroborative of the fact long since stated, that our mines are absolutely yielding a higher income at present, than at any former period, with a less amount of work expended. There are no pretensions to accuracy in the above figures, as no fractional amounts are included, which would have swelled the amounts given, to a material degree. They are intended to convey but a general idea of what labor will command in the mines of the State, from one portion of the mining section to any other extremes thus far known.

From what has been said of the areas comprised within the lines of the different ranges, as given in the preceding pages, it will be seen that we have still enough and to spare for all who are present, and for all that may hereafter arrive, for at least the next half century. There need be but little fear of their failing to yield their annual crop of gold, as long, perhaps, as our valleys will yield their crops of grain.

The aggregate areas amount to about eleven thousand square miles, that is known to contain gold; and, when this is compared with the area actually occupied, the latter will be found to comprise but a mere mite of our available resources. With our present population of the mining districts, and the broad expanse of territory over which they are spread, they appear like mere specks, dotting the surface of an inland sea, so indistinct as scarcely to be appreciable on the broad expanse by which they they are surrounded.

QUARTZ VEINS.

In my report last year, it will be seen that the quartz veins of the State were divided into separate groups denominated the older and recent groups, each having a different age and apparently belonging to different geological periods. These were again separated into three divisions, each occupying certain districts of the State, and the divisions, of the older group were found running in lines nearly parallel with each other.

It will be necessary briefly to allude to the relative disposition of these veins among their investing rocks in order to obtain a better idea of the positions and relations of other veins which have been developed with the year that has passed.

That group which was denominated the "older," and which includes the eastern and more central line of dikes that traverse the inland districts of the State pursue a strike which is nearly

north and south. This intrusion occurred evidently during the period immediately preceding the upheaval of the rocks belonging to the tertiary epoch, the proofs of which are found in the fact that in no instance are they known to have disturbed the rocks of that date, though often found closely adjoining the latter, and which in some instances are found to overlie the dikes themselves.

The uniformity which these rocks present in their latitudes with the rocks by which they are invested, compels us to admit that they must be regarded as a distinct group, equally as marked in feature as are any of the different beds which go to make up any series found in the sedimentary rocks of any portion of the State.

To the west of this suite of veins, are found the more recent dikes, and which were called the "recent group." These extend from the edge of the plain eastward for about fifteen miles, and in some few instances have been found intruded among the rocks of the preceding period.

The peculiarities that remove these veins from the former, is found in the fact that they have disturbed not only the primitive but also the most recent of the tertiary rocks of these districts, and as late as the *pliocene* group in other parts of the State, abundant evidences of which are met with in many parts of the coast mountains.

The course of the recent dikes diverges from those of the older at an angle of about twenty-four degrees, their mean trend being south twenty-four degrees east, and north twenty-four degrees west. Were these peculiarities merely local, we might with some degree of reason assign to the entire series a contemporaneous age; the characteristics noticed pervade so great an extent of country that we should find some difficulty in demonstrating that they made their appearance among the other rocks during one and the same period.

In addition to the preceding series we have now to consider another and distinct set of veins which have been developed and clearly defined during the past eighteen months. These are the east and west veins, which often cut former dikes at nearly right angles, and when first seen were regarded as branches of the north and south lodes; but subsequent observation has established the fact that they are an entirely independent group.

At present their are eight localities in the State at which these veins are known to occur, four of which are found to cut the older veins, and the other are located among the slates of the tertiaries. We have no means as yet of determining the fact with any degree of certainty, whether the east and west veins are older or nearer than the tertiary dikes, but what evidences there are existing lead to the inference that they preceded the latter. This presumption is based upon the fact that where the east and

west veins are noticed among these rocks, there is not the same evidences of disruptive agency as at those points where they are found in contact with the older veins. The information in our possession relative to these dikes throughout the State, is such at present that we are enabled to arrange them in somewhat a more systematic order than has heretofore been presented.

The table below will present at one view the different systems that are at present known, and which are beyond all question; but it is not to be supposed that those presented comprise all that will ultimately be developed among the metalliferous lodes of the State. Others might be added to the present list, were we to adopt the plan of arranging a system from surface features alone, but we prefer waiting until those lodes which present indistinct evidences of being unconnected with the others, shall have been definitely settled by subterranean openings, for nothing can be lost by the delay.

SYSTEMS OF VEINS.

No. 1—North and South Veins.
No. 2—East and West Veins.
No. 3—Northeast and Southwest Veins.

The above are the only lodes yet known, and the former division of the groups will still be retained until such time as the effects of the east and west veins on the recent or tertiary dikes shall have been ascertained. The rocks disturbed by each system will be found as follows:

SYSTEMS.	GROUPS.	ROCKS DISTURBED.
North and South Veins.	Older.	Primitive.
East and West Veins.	Median.	Primitive.
Southeast and Northwest Veins.	Recent.	Tertiary Slates and Sandstone.

The dissimilarity in the metallic constituents of these systems is worthy of remark, as well also as the peculiar dispositions of the metal itself. In the first and second cases we find but little disposition to the crystalline form in any of the veins yet explored, while in the other, the metal more frequently assumes this character, and the percentage of silver is also much greater.

The constituents of the veins are equally well marked; the ores of lead are far more common in the east and west lodes than that usually found in either of the others. As a general fact, it may be stated that the metal from the placers in the immediate vicinity of these veins often bears but little analogy to that found in *situ* among the rocks of the district in which the latter are situated. It is not uncommon to find gold of a very low carat in a placer, while that of a metallic lode adjoining would be correspondingly high, and the reverse of this is also true.

The gold of the North and South veins is usually destitute of any crystalline form with the exception of one or two instances,

while that from the east and west veins possesses this character in a much higher degree. These lodes also contain the largest amount of other metallic compounds, as lead and copper, the first of which is frequently productive of silver; I have seen gold from one of these veins producing five per cent. of that metal; the assay was made at the United States Mint of this State.

These points leads to interesting inquiries relative to placer gold, and when fully understood, will settle many of the discrepancies that now obtain in relation to the variable character of the metal produced from these districts; and will ultimately be the means of determining the relative ages of such deposits.

From mining explorations we are constantly acquiring information of the distribution of the metallic lodes of the State, and the day is not far distant when all the different systems of productive veins will be fully understood and their peculiarities noted with that precision which the necessities of this department of business demands, and an intimate acquaintance with the changes that occur in these lodes is now being understood as necessary in prosecuting this business with advantage.

There is a manifest disposition in the veins below the surface to produce silver, and as before remarked that tendency is much the strongest in the Median set of veins. Associated with the galena of those lodes, molybdenum and tellurium are common attendants throughout, and when these veins shall have been carried to near those depths to which similar operations have been conducted in other countries, we may confidently look for a supply of this metal that will be but little inferior to the present product of gold.

QUARTZ MINES.

The operations in this department have continued active during the past season, and the number of mines is on the increase. So far as the workings have been conducted on the lodes during the past year, there are no farther evidences of pinching out than was presented in my former report. But to the contrary, the majority of the veins have increased a little in power, or have maintained fully that to which they had arrived last year. The greater proportion of the mines have been carried to more depth than before attained.

Of the total number of mines reported in active operation during the year, there are thirty-one still engaged, nine of the number having suspended during 1854. Of the total number suspended, five can be considered but temporary, as two are erecting new reduction works, the other three have ceased to reduce ores from the inefficiency of their machinery, and it is not probable that they will again resume operations until the means of transportation is such that heavy freights can be conveyed to near the districts in which the latter are located. At present the only trans-

portation to the sections is upon the backs of the mules and horses, and those acquainted with the requisites of machinery for the reduction of ores will readily perceive the inadequacy of such material as could be conveyed over rugged mountain trails by the latter process.

The parties owning these mines have not abandoned the enterprise on which they entered, but will await the time when the avenues of communication afford advantages superior to those at present in use, and which will undoubtedly be opened during the present year.

The remaining four companies that have stopped their operations, I am unable to give any cause for, as the parties who had the control of affairs were absent at the time I visited the districts. The report of those in the vicinity of these mines, in relation to the cause of their suspension, was not of a favorable character for their early resumption, but I should be unwilling to say that a mine was valueless upon such evidence, as private interests often exaggerate unfavorable circumstances above their true color. The four last are in reality all that can be considered as permanently suspended, and the five preceding are at the best but temporary, as three of the number will resume work about the beginning of June, and the remaining two probably as early as September next.

In the immature state of this branch of industry, and the inefficiency of machinery, with the difficulty of commanding often the necessary amount of capital to conduct these operations to a successful termination, the ratio of ten per cent. of those who fail cannot by any means be considered as very large. And when it is compared with similar transactions in this State little more than two years since, the above sinks into insignificance. Or, if we look to more distant regions, it will not be difficult to find more than a parallel in the operations that transpired in the early days of the Lake Superior mines. The history of mining, either in the United States or Great Britain, when carefully examined, will not present a broader margin of successes than is to be found in the gold mines of this State since it became what might be considered a settled business, and the position which they hold as sources of profit, with an increasing confidence, is the best proof of their value. As we are situated in this State, these mines are subjected to the most severe test which it is in the power of man to inflict upon a business of this character. It is the test of intrinsic merit, and though invidious clamors are at times uttered, and often by those who have never taken the pains to inform themselves as to their native riches, still these even grow fainter as each succeeding month brings to light new evidences of success.

Had we the same facilities of exhibiting the characters which our gold mines present, through the agency of mining journals

and jobbing boards, like those in New York, Boston, and the English metropolis, we have no fear but that the mines of this State would take their position in the front rank of those operations. But unlike the mines abroad, they do not require at home the prestige which fancy paper throws around the many faltering institutions of our distant neighbors.

That our mines have thus withstood the violent assaults that have been made upon them by those who stand behind the scenes of a foreign press, and thus attempt to give a fatal thrust unseen, is one strong evidence that they inherit a vitality which it is beyond the powers of those in this State still thus employed to deprive them of. We have passed that day when either British *skill* or capital is required to foster these operations, and the evidences are strong, that under the circumstances, as they have proved themselves, we should have been far better conditioned had their attention been directed to other, and probably to them more congenial channels.

We had expected to have received instruction in the mysterious art of mining from a people who boast the knowledge of centuries of experience in that profession; but to their own astonishment, American miners in California have become their tutors. I would not be guilty of casting envious reproaches upon foreign friends, but justice to ourselves demands that the FACTS should come out.

Another argument which in itself carries weight in regard to the integrity of these mines, is the fact, that none of those at present engaged exhibit the slightest hesitancy in embarking in additional enterprises. This is proved from the fact of a constant addition of new reduction works in different parts of the State, and more particularly in those counties where the mines have been opened to the greatest extent. It is hardly a supposable case, to believe that men would thus coolly invest in speculations that require sums varying from fifteen to fifty thousand dollars, which three years experience before them has demonstrated to be a failing and unprofitable business. We might torture the fact into such a conclusion, but the exercise of a little reason would be likely to dictate otherwise.

At the present time we find parties entering the field with new and increased facilities at their command (and who, from mismanagement, in times gone by, have lost heavily), and are now realizing their most sanguine expectations from a judicious management of those operations in which they formerly failed to succeed.

The greater proportion of those who have embarked in this business within the past year, are men who have heretofore lost heavily in the same business. Their experience of former days taught them somewhat a severe lesson, but at the same time, they learned enough of the value of these metallic veins to inspire that

confidence in ultimate success which they are now realizing in an eminent degree. This proves that their confidence was not misplaced, and the only error committed in the premises was too hasty and inconsiderate action, and the use of means inadequate to secure the desired end.

Gold mining in this State has arrived at such at point, that it is now looked upon by those in he least conversant with the business, as one of the principal and best employments for capital and labor; yielding a higher rate of profit for the means employed than any one branch of mercantile pursuits at present known in this country; and as an evidence of this it will be but necessary to state that several of the mercantile men of the larger cities have withdrawn their capital from their former pursuits and invested the same in the latter. It is a rare thing to find one of these mines doing a losing business, for it has become a settled principle, that the lodes will pay the expenses of opening the mine, and there are but few that do not do it.

Numerous instances of this character are found in the State, and so well has this been demonstrated, that those who engage in this business seldom fail to realize that result. One of the best examples of this is the case of one of the mines in the county of Amador, the aggregate expenses of which, in opening their mine and the erection of their reduction works, amounted to seventy-one thousand dollars, while the receipts from the mine, consisting of ore removed from the shafts and galleries in opening, amounted to sixty-two thousand, the engine of the mill costing over twenty-two thousand. In this case the opening of the mine paid nearly the entire expenses of the concern. This is not an isolated instance, it is mentioned as illustrating what we have formerly said on this subject, and is stated as a fact which speaks louder than words.

Such is a brief history of the general phases which are presented in this branch of employment at the present time in this State, and with what has been said relating to this subject in my former reports, may serve, perhaps, to correct some of the erroneous impressions that still attach themselves to this important source of wealth, and which are as groundless as the wind. The sun of that day has set, when it will again be in the power of any man, or set of men, to again wreck that confidence which now reposes in the value of the gold mines of this State; their results have placed them beyond the reach of cavil, and beyond the shade of doubt.

Art II.—CONDENSATION OF METALLIC FUMES.

In all great smelting works of lead and copper, the smoke rising from the furnaces is highly charged with the most noxious vapors, containing, besides other poisonous matter, a large quantity of lead. Many attempts have been made to obviate this nuisance; and the system adopted by the exhibitor has been found to be very successful.

An oblong building in solid masonry, about 30 feet in height, is divided by a partition wall into two chambers, having a tall chimney or tower adjoining, which communicates with one of the chambers, at the bottom. The smoke from the various furnaces, eight in number, and about 100 yards distance from the condenser, is carried by separate flues into a large chamber; from thence by a larger flue it enters the first chamber of the condenser at the very bottom, and is force upwards in a zigzag course towards the top, passing four times through a shower of water constantly percolating from a pierced reservoir at the summit of the tower. The smoke is again compelled to filter a fifth time, through a cube of coke, some 2 feet square, through which a stream of water filters downwards, and which is confined to its proper limits by a vertical grating of wood. The smoke having reached the top, is now opposite the passage into the second or vacuum chamber.

This is termed the exhausting chamber, and is above 5 feet by 7 feet inside, and 30 or more feet in height. On its summit is fixed a large reservoir, supplied by an ample stream of water, always maintaining a depth of 6 to 10 inches.

The bottom of this tank is of iron, having several openings or slots, 12 in number, about an inch in width, and extending across the whole area of the reservoir, communicating directly with the chamber beneath. On this iron plate works a hydraulic slide plate, with openings corresponding in one position with those in the reservoir.

This plate receives a horizontal reciprocating motion from a water-wheel or other power, driven by means of a connecting-rod and crank.

In the middle of every stroke, the openings in the plate correspond with those in the bottom of the reservoir, and a powerful body of water falls as a shower-bath the whole height of the vacuum chamber; and, in doing so, sweeps the entire inside area, carrying with it every particle of insoluble matter held suspended in the vapors coming from the furnaces.

The atmospheric pressure, of course, acts in alternate strokes as a blast at the furnace mouths, and causes a draft sufficiently strong to force the impure vapors through the various channels

in connection with the water, the wet coke and exhausting chambers, until it passes, purified and inert, into the open atmosphere.

The water saturated with particles of lead, &c., held in mechanical solution, finally passes into great dikes or reservoirs excavated for the purpose; and then deposits at leisure its rich charge of metal.

Formerly, the noxious fumes passing from the shafts of the furnaces poisoned the neighborhood; the heather was burnt up, vegetation destroyed, and no animal could graze or bird feed near the spot.

Now, the green heather is seen in all its native luxuriance close around the establishment; and the sheep graze within a stone's throw of the chimney's base, and game on all sides take shelter. —*By the Duke of Buccleugh.*

Art. III.—GEOLOGY OF WISCONSIN.

Vertical seams of mineral occasionally pass from one course to another, or traverse the opening as cross sheets, and at the crossing of these, or even of a barren seam only, there is usually an increase of mineral in the flat courses, sometimes enlarging them so as to form geodes lined with regular cubes. When vertical east and west crevices traverse these openings, they usually carry a vein of mineral arranged in vertical order, intersecting the flat courses; but in some instances I have observed such vertical veins on the sides of the openings, inflected under the roof into the horizontal course, with an enlargement of the mineral at the turn, sometimes forming there a geode. In some instances, the vertical crevices, which have been traced from the rock above into or between the flat openings, have been found to carry mineral more or less through their whole extent; but in other instances, the mineral extends in them little or not at all above or below the opening.

The lateral limits of these flat openings are generally marked by a slight turn in the courses of mineral from a horizontal to a vertical position at the sides of the opening, beyond which the rock soon loses its opening character; thus showing the definite extent of these horizontal deposits.

Some peculiarities, worthy of notice, are observed in different localities. In the flat openings at Benton, particularly at Swindler's ridge, a layer of hard rock, 1—2 feet thick, called the false cap, immediately overlies the openings, above which is a layer of flints, usually accompanied with a flat sheet or course of mineral,

often of workable value. This layer requires support, and when such support is withdrawn, after the opening is worked out beneath, soon falls and exposes the mineral above it. The rock above, called the true cap, usually remains firm, even in the widest openings. In the flat openings at New Diggings, a layer or bed of hard rock with flints, about three feet thick, overlies the opening rock, and is overlaid by a thin subargillaceous layer, called the gray shale, apparently of a concretionary structure, and interrupted by mineral, arranged in a horizontal sheet form, detached or more connected. The rock above this contains very few flints; the proper flint stratum commencing in the bed immediately below it. A layer closely resembling the gray shale in character occurred at the Dry Grove Diggings, west of Benton, in sinking on a vertical sheet, at the upper surface of the flint bed.

The flat openings of the flint bed, occupied by the calico rock, are found throughout a large portion of the mineral district, where openings have been worked in that bed, and are the most general and characteristic of those in that bed. I have observed them, well marked, at Beetown, Potosi, Brushhill, Platteville, Elkgrove, Benton, New Diggings, Shullsburg, and the Dreadnought mine, near Mineral Point. In some of these openings, the rock is much more disintegrated than in others; its ground, in such cases, being reduced to the state of loose sand, with more or less tumbling rock; while in others, although distinctly marked, the rock is so hard as to require blasting. Openings of the former kind are called sand openings, and are common at Benton, while at Shullsburg openings of the latter kind are more frequent.

Occasionally in the localities above mentioned, and more so in the more eastern diggings, the mineral is collected more in bunches, particularly along the line of vertical crevices, and is then more accompanied with clay and iron, and more disposed to assume regular cubic forms, approaching in these respects the arrangement in the vertical openings in the upper bed. But in such instances, the intervening rock is more or less altered and stained, the whole forming a common opening. In some cases, as at Chenaworth's mine, near the Dreadnought (above noticed), this arrangement in bunches, along the lines of crevices, appears to have arisen from masses of rock, intersected throughout, as in the calico rock, by distinct seams of iron pyrites, accompanied with more or less mineral, which by their decomposition form masses of ochry earth and hematite, including the mineral as in the rock. These masses are sometimes so rich in mineral as to be very productive. Sometimes they will be found entirely decomposed; at other times, only partly so; and even in some instances, entirely unchanged; thus showing satisfactorily the origin of the former from the latter, and heir relation to the calico rock. It might indeed be expected hat where the pyrites are so concentrated, as in these instances,

it would be less extensively diffused through the rock, and more segregated in bunches, whereas the calico rock, in which the pyrites is more disseminated, would be found characteristic of larger and more uniform openings. This arrangement in bunches is more peculiar to the flat openings, east of the parallel of Shullsburg and Mineral Point; but these openings form ranges as regular in their course as the more uniform flat openings farther west.

Calcareous spar is generally very rare in the flint openings; but occasionally it is found, either disseminated through the opening rock, or more frequently accompanying the layers of flint and mineral; the regular order from above downwards, being then calcareous spar, flint and mineral. Even in some instances, where there are no traces of a mineral opening, calcareous spar is found accompanying the layers of flint in the same order. I have observed, in one instance, in Stephens' mine (Shullsburg), a mass chiefly composed of calcareous spar (tiff), occupying a large extent of an opening, and arranged like the masses of hard blue pyritiferous rock in some openings, as in Champion's level (New Diggings). These masses rise sloping inwards from the bottom of the opening to a ridge near the roof, and apparently extend downwards in the manner of a lode, but have not been proved in that direction, and terminate abruptly or taper out at the extremities. The mass of tiff, in Stephens' mine, terminates abruptly towards the west, and apparently tapers out towards the east. At its west end it is bordered by a thin layer of hard rock, in nearly a vertical position, as if out of place, but more probably formed in its present position by segregation. This layer is traversed by small vertical veins of mineral, and in the calcareous spar adjoining, which is there more massive, the mineral is found accumulated, usually in very regular cubic forms, although closely imbedded in its matrix. In some other parts of the mass, similar accumulations of mineral were found, but in general the mineral is only sparsely disseminated. The entire mass appears to be a portion of the rock arranged conformably to the stratification, the greater part of it composed of the calcareous spar, disposed in segregative order through a base of the granular limestone, through which iron pyrites, and more or less of copper pyrites, are disseminated; the latter also collected at particular points in small bunches.

The flat openings in the flint bed are usually not more than four to six feet in height, particularly the wider and more uniform openings, and two openings are generally found, one above the other, separated by a layer of hard rock, about two feet thick, forming the cap of the lower. In a few instances, a third opening has been found. These may all be considered as one common deposit, with which the flat sheet above the false cap is connected. These openings, like the vertical openings in the upper bed, sometimes rise and fall in their course, by a succession of flats and pitches; or this rising and falling, as in the latter, is only confined

to the mineral, the opening remaining unchanged. The most uniform flat openings are more or less subject to interruption in their course by transverse bars of rock, and in some instances the detached portions have a form more or less rhomboidal, analogous to the form of the bunches observed in some vertical east and west ranges in the upper bed (p. 44), and also succeed each other in a corresponding order. This is observable in the flat openings at Swindler's ridge (Benton), where the longest diameter is from north-west to south-east, corresponding to the general direction of the ranges (E.S.E.)

In the lower bed of the upper magnesian, flat openings are the most general, and even more extensive than those in the flint bed. In some instances, such openings have been worked across more than a hundred feet, without reaching their limits. In one instance (at A. Looney's level, north of New Diggings), a side drift was carried from the middle crevice near fifty feet before reaching the limit of the opening ground. This limit was very distinctly marked by a vertical line, the adjoining rock losing at once the peculiar characters of that of the opening. I have already observed that the rock in the lower bed is less uniform than that in the flint bed, and the same is true of the openings. The black or brown rock and the green rock, in their different districts, have important connections with these openings, generally overlying and including them, whence they are usually called the black or green rock openings. In some instances, however, the rock in these openings resembles that of the flat openings in the flint bed, or the calico rock, and is then more or less accompanied with layers or nodules of flint, which seem to be confined to the opening rock, or are at least most abundant in it. But even then this opening rock is distinguished from that of the flint bed, by the great abundance of calcareous spar (tiff) disseminated through it, as is common in the brown rock, and usually more or less of it has, by this stain, the character of that rock. When the opening rock resembles the calico rock of the flint bed, the adjoining rock is usually very hard and compact, and of a light gray color, resembling the hard nodules found in the opening rock, particularly of the flint bed, and the more compact layers of the upper bed of the blue limestone. This adjoining rock is destitute of the ferruginous stain and the disseminated tiff, characteristic of the openings.

In this lower bed the mineral is usually found more accompanied with the sulphurets of zinc and iron than in the two upper beds. The sulphuret of iron, or the result of its decomposition, is always present more or less in the openings in the upper beds. Usually the sulphuret has been there converted into the oxyd, causing the ferruginous stain and the deposits of ochre and hematite (iron rust) found in those openings. The sulphuret of zinc (black-jack) and the carbonate (dry-bone), the result of its decom-

position, are more rare in the upper openings, but are occasionally found there, more frequently, so far as I have observed, in the vertical openings in the upper bed, than in the flint openings. But there is a class of veins (the flat and pitching sheet veins), which have been traced through all the beds of the upper magnesian into the blue limestone, in which zinc ores are usually found more or less accompanying the mineral. Not only in these, and in those instances where the zinc ores accompany the veins in the upper vertical openings, but also in those where they accompany the mineral in the flat openings of the lower bed and the blue limestone, there is an order of arrangement which I have found invariable. When the ores of lead, zinc and iron are all present, the iron ores are arranged in a sheet or layer next the rock, then the zinc, and then the lead, in succession, towards the interior of the opening. In the Marsden lead, below Galena (a flat and pitching sheet mine), where the mineral is usually accompanied with zinc and iron, this order is distinctly observed, and in different geodes, processes, like nipples, are observed projecting into the cavities or geodes between the cubes of the mineral, which are found occupied in the centre by a square process from the sheet of iron pyrites, like an elongated cube, surrounded with a coating from the black-jack, sometimes with points of mineral adhering to the surface. The flat and pitching sheet veins with zinc and iron, usually called flat and pitching dry-bone sheets, have been found to commence in the upper bed of the upper magnesian, and have been traced down through the different beds of that rock and of the blue limestone to the upper sandstone. At the west end of the Heathcock range (Linden), the same sheet has been followed down from the flint bed to at least ten feet in the upper bed of the blue limestone, and is there found large and productive, and without any sign of interruption. These veins appear indeed to be the most uninterrupted, and in some instances have been worked more than twenty years without exhaustion, and with a very uniform product.*

The ores of zinc are rare in some of those flat and pitching veins, the mineral being then connected immediately with the ores of iron. But where the zinc ores are more abundant, they are sometimes nearly or quite wanting in parts of the vein, and then usually the lead ore is increased in proportion, while in other parts of the vein the zinc ores predominate. Thus in one part, the vein will be found narrow or divided in the rock of the opening, and the mineral more or less disseminated in the zinc ore, so as to require separation by crushing and washing; then, where the vein is wider, the mineral will form a middle sheet, detached from the zinc ore, and where still wider, a geode will be formed, and the mineral be arranged in cubes on the interior surface of the zinc

* This is reported of the Heathcock range (Linden), and the dry-bone mine on Bull Branch (Benton), both of which are still worked to advantage.

ore. Still farther in its course, the zinc ore will disappear, and a thick and solid sheet of mineral be found, separated from the rock only by a seam of iron. Such thick and solid sheets are usually found on the flats, and the geodes at the turn from a flat to a pitch, extending more or less along the latter. These flat and pitching veins sometimes pitch in opposite directions from the same flat, forming what is called a saddle-back. In some instances, such a flat is apparently at the highest part of the vein, forming a longitudinal ridge along its middle, from which it pitches on each side, either in one uniform slope, or by alternate flats and pitches. Such is the arrangement of the sheet in the Heathcock range, where it forms a flat, at its summit, in the flint bed, from which it pitches on each side into the lower strata; on the south, at least into the upper bed of the blue limestone. This flat is much wider towards the west, where the sheet pitches on each side more uniformly, but narrows out towards the east, where the sheet pitches uniformly on the north, but on the south, descends more in alternate flats and pitches, and apparently divides into 4—5 smaller sheets, connected in a common opening. In some instances, such flats are only on the general pitch of the vein; the vein rising, then turning over a flat, and then pitching again in its regular course. I have not yet had an opportunity of tracing such a vein lower than the upper bed of the blue limestone; but I have been informed by J. Bracken, Esq., that such a vein, in the Victoria range (Mineral Point), was followed down to the base of the blue limestone, and that the accompanying zinc and iron ores were even traced into the upper sandstone. These veins, like the vertical sheets, thus appear to have an extensive range through the strata, and are not confined to one particular bed, like the flat openings in the lower strata, and the more limited vertical openings in the upper bed of the upper magnesian.

The flat openings in the lower bed may be divided into three classes: sand, ochre, and dry-bone openings. The first class includes those where the opening rock resembles the calico rock of the flint openings, and is usually accompanied with more or less flint, like the latter. The mineral is here arranged in flat courses, or disseminated horizontally through the rock, as in the flat flint openings. These openings, too, are traversed by vertical crevices (either of more uniform width or forming a series of pockets), usually occupied by loose materials, and adjoining which the rock is more decomposed than in the remoter parts of the opening. The mineral is most abundant in the loose ground of these crevices, and in the adjoining parts of the opening, where the rock is most altered. Generally, in the loose ground of these crevices, a much greater quantity of iron is found, in the form of unaltered pyrites, or recomposed into ochre and hematite, than in the openings or crevices in the upper beds. In some such instances, the iron pyrites appears to have replaced the mineral, and extensive bars oc-

cur in the course of the crevice, in which the mineral is wanting, but the iron ores are proportionally more abundant. Such a bar, at the west end of A. Looney's level, in the middle crevice of the opening, replaced the mineral, after it had continued productive for 800—900 feet, and in this the ores of iron were found in every stage from the original pyrites to the ochre and hematite, exhibiting, in their change, fine specimens of green copperas, and small pockets of alum, where clay was more abundant, and also, though more rarely, of native sulphur. This mass is now partly worked out, the former character of the opening being resumed beyond it. The loose materials in these crevices are arranged conformably to the stratification; the layers of flints crossing them regularly in the line of those in the adjoining rock, only sometimes slightly lowered by the settling of the materials. This loose ground differs from the adjoining rock only by a greater proportion of clay, sometimes forming layers, or segregations investing the mineral as a matrix, and by the quantity of iron intersecting it in the manner already described (p. 47—8.) The more altered rock adjoining resembles the corresponding rock in the flint openings, and is more or less disintegrated in the state of loose sand.

The ochre openings are characterized by the great abundance of iron ore (iron pyrites and the results of its decomposition) accompanying them throughout their extent. Clay also abounds in them, in layers and pockets conformable to the stratification, and in seams corresponding to the outline of the opening. This clay is strongly marked by the smooth joints common to the clay openings, particularly to the seams of clay which traverse and line them, and is called joint clay and soap clay, by the miners. The latter term is more particularly applied to a bluish clay breaking in small jointed fragments, which usually invests the mineral when imbedded in clay. The mineral, in these openings, is either arranged in uniform horizontal courses, or in a series of flats and pitches, limited to the openings. In the former case, it resembles, in its arrangement, the mineral in the flat flint openings, but is more connected with clay and iron. In the latter case, it is arranged more in sheet form, bordered by a sheet of iron, and replaced by the same, when interrupted. Usually the mineral is largest and most uninterrupted on the flats, or on the turn from a flat to a pitch, and is smaller and more interrupted, and often entirely wanting, in the pitches, resembling, in this respect, that in the flat and pitching veins already noticed. A remarkable instance of this occurs in a very productive mine, worked by Earnest and Spenceley, on the Shullsburg branch, north of New Diggings.* The zinc or dry-bone openings are, on the whole, the

* I have observed in some of the ochre openings, layers or more detached masses of a white limestone, usually much disintegrated in the state of sand. A similar rock also occurs in the Upper Pipe-clay openings in the blue limestone.

most frequent in the lower bed, though in some instances more rare, particularly in the eastern districts. In these the mineral is arranged in sheets, with the ores of zinc and iron, in nearly or quite the same manner as in the flat and pitching dry-bone sheets already noted. The same order is observed in the arrangement of the different ores in relation to the rock, and the same arrangement of the mineral in the sheet, sometimes disseminated in the zinc ore, and sometimes forming a separate sheet, between the lateral sheets of zinc, but more usually, in these openings, the former. The sheets in these openings are sometimes regularly horizontal, but more usually uneven, presenting a series of flats and pitches or undulations, sometimes along slopes of large extent and pitches in different directions, but still limited by the extent of the opening, both in a vertical and horizontal direction. In some intances, although these sheets have been worked to the width of a hundred feet, their lateral limits have not been reached, their sides thinning out so as not to repay the expense of working. In these dry-bone openings different sheets are found, as well as different courses in the flat flint openings; usually one near the roof, and another near the floor, and sometimes others intermediate, the whole more or less connected by cross veins or seams. The opening rock is usually very much decomposed and stained, and more or less accompanied with seams and pockets of clay, as in the ochre openings. Both the ochre and dry-bone openings are traversed by vertical crevices, in which the mineral is arranged in vertical vein order, and is more regular in its form, as in the upper vertical openings. The mineral in these crevices, when they traverse the dry-bone openings, is not accompanied with zinc ores, but resembles that in the crevices in the ochre openings. Usually the mineral in the flat openings is larger and more abundant adjoining the crevices, and in the dry-bone openings the sheet is enlarged, and the mineral more distinct from the zinc ore, sometimes even forming geodes. The dry-bone and ochre openings generally alternate, either one by one, or in successive groups. In some instances, the same range will in one part of its course be an ochre opening, and in another, a dry-bone opening. I have known the same range commence on the west with a mass of iron ore, then become a productive ochre opening, and terminate towards the east in a dry-bone opening.

The great quantity of calcareous spar (*tiff*) disseminated in the opening rock, and even in the rock generally, in the lower bed, particularly in the brown rock, has been already noticed. In some of the openings in this bed, large masses of calcareous spar are found, usually in horizontal courses, with more or less of a geodic arrangement, the crystals aggregated so as to present the appearance of rounded bosses of a peculiar form. These masses usually occur along the lines of vertical crevices, and are sometimes found in such cases in small caves; the opening being only partly filled with the spar and and loose material accompanying it.

The latter are usually derived from the decomposition of subargillaceous layers, more or less accompanied with iron pyrites, and sometimes with the black oxide of manganese (black ochre).

Beds or bars of pyritiferous rock also occur in the openings of the lower bed, more remarkable even than those in the openings of the flint bed. They either underlie the opening rock near the base of the upper magnesian, or rise in the openings, as has been noticed of the bars in the flint openings, and consist of regular beds of the limestone, nearly filled with seams and bunches of iron pyrites, accompanied with more or less calcareous spar;* the whole forming by its decomposition a bed of ochry earth and hematite, and presenting during the process of decomposition the same appearances as have been noticed in the bar at the west end of A. Looney's level. In one instance (at Blinkiron's mine, north of New Diggings,) I observed such a bed underlying the opening, and overlaid by a bed of bluish gray limestone largely filled with bunches and geodes of calcareous spar, in small and often very perfect tabular crystals of great clearness and beauty.

The openings in the lower bed, particularly in the eastern districts, sometimes present a succession of pockets or bunches traversing the general opening rock, corresponding to a similar arrangement in the flint openings. In some instances, I have observed such an arrangement in smaller upper openings immediately overlying the large and uniform flat openings in this bed. The brown or black rock generally accompanies the openings in the lower bed in the south-western districts, and the green rock in the north-eastern districts; whence at Mineral Point and in its vicinity, the openings in this bed are known as the green rock openings, while in the south-western districts they are called the black rock openings.

In some instances, detached vertical crevice openings are found in the lower bed, traversed by a vertical vein, from which flat courses of small extent (2—3 feet) enter pockets in the sides of the crevice, showing a tendency to the formation of a wide, flat opening, traversed by a vertical crevice and vein. These resemble the openings of an intermediate character between the vertical and flat openings, already noticed in the lower part of the upper bed.

Small quantities of copper pyrites have been observed, in different instances, in the openings in the lower bed, particularly in the vicinity of Fever River, accompanying iron pyrites or calcareous spar. Frequent traces of it occur in the masses of iron pyrites in the openings of the lower bed at W. Gillet's diggings (Buncomb), and in connexion with the large masses of calcareous spar in openings in the same bed, above noticed, in different ranges

* The calcareous spar generally forms segregations invested by the iron pryites, and on the decomposition of the latter is sometimes found changed to the sulphate of lime (selenite).

between Fever River and the Shullsburg branch, east of Benton. In the latter case, the copper ore occurs near the junction of the spar with the rock, where the two are more or less blended, much in the same manner as it occurs in the large mass of tiff in Stephen's mine (Shullsburg). The copper pyrites is always accompanied, in these instances, with more or less of the green and more rarely with the blue carbonate. The copper ranges at Mineral Point have also been worked chiefly in the lower bed.

It has been a common opinion that the blue limestone cuts off the mineral, and this has been understood of the blue limestone of Owen, or the formation immediately underlying the upper magnesian. This opinion has properly no reference to that rock, but to beds of hard blue rock found in different positions in the upper magnesian, which in many instances have been known to interrupt the mineral in its descent, both in sheets and in wider openings. This rock is usually more or less intersected with iron pyrites, and has been found at the bottom of openings in all the beds of the upper magnesian, and sometimes rising into the openings and forming obstructions in their course, or intervening as a bar between contiguous openings. It may be considered as properly an opening rock, and when cutting off the mineral, as playing the same part as the masses of loose ferruginous materials which interrupt the mineral in the course of openings or veins, particularly in the lower bed of the upper magnesian. I have described the different openings, in their descent, as forming series at different levels; two in the upper bed (the upper and lower), the flat openings in the flint bed, and those in the lower bed (the brown and green rock openings). These beds or bars of pyritiferous rock appear to underlie occasionally all of these openings. In sinking on a vertical sheet traversing different beds, it is found liable to interruption on meeting such bars, but not always so; instances having occurred in which the sheet has traversed them, but usually more or less diminished in its passage. When such a bar underlies an opening, or interrupts a vertical sheet, usually for a certain distance beneath, more or less of the mineral is disseminated through it in particles or seams. I was informed by Mr. Haskins of Dodgeville, that in one instance, a vertical sheet, on which he was employed, was cut off clean by a floor of blue limestone, only small particles and seams of mineral being found in it for a short distance below the sheet. On examining the rock, I found it was only a modified portion of the common rock of the locality (the flint bed of the upper magnesian), forming such a bar as I have described.*

* These bars have been met in sinking below the different openings, and in following down vertical sheets, and from their great hardness have discouraged from farther pursuing the mineral downward. From observation it has appeared to me evident that they are parts of a mineral range, in which iron

The blue limestone of Owen is a good mineral-bearing rock, and like the upper magnesian, not only has its openings in each of its three beds, but is traversed by vertical and pitching sheets or veins, which in some instances are said to have been traced through it to the upper sandstone. I have myself traced pitching sheets from the upper magnesian into the upper bed, and vertical sheets to the lower bed or buff limestone. The regular openings in the blue limestone are wide and flat, like those in the two lower beds of the upper magnesian.

The openings in the upper shell bed are called the pipe clay or brown rock openings. The former name is taken from layers of clay which traverse the openings, derived from the decomposition of the layers of shale which are interposed in the upper bed; the latter, from a bed of brown rock, already noticed, immediately overlying the upper bed, and forming a more or less immediate cap to the openings. These openings are merely a certain extent of the rock, which has suffered more or less decomposition, and through which the mineral is disseminated in flat courses, usually imbedded in the layers of clay aboved noticed. The rock in these openings is, on the whole, less stained than in the openings in the upper magnesian, and the mineral is less accompanied with iron. It is also more regular in its form, sometimes in very perfect cubes, but more often tabular, varying in size from very small, called dice mineral, to very large; the latter usually adjoining a vertical crevice. The mineral, whether large or small, is imbedded in the clay or shale, in the same manner as iron pyrites in pyritiferous shales, and is either quite isolated, or a series of cubes or tables is arranged in horizontal vein order, sometimes forming sheets of considerable extent. These openings are usually wide, sometimes equalling in width those in the lower bed of the upper magnesian, but in such cases the mineral is more confined to the vicinity of vertical crevices, although the intermediate rock is much decomposed, and contains more or less mineral disseminated.

In some instances, I have found this change in the rock, with the accompanying mineral, extending only a few feet (6—8) on each side of a vertical crevice; the adjoining rock having the usual characters of the unaltered blue limestone and abounding in fossils, while in the altered rock of the opening the fossils are so decomposed as to be hardly distinguishable. In some instances, as in the Irish Diggings near Mineral Point, the openings in this bed are very ferruginous, and the mineral is then sometimes accompanied with zinc ores, forming flat sheets similar to those in the lower bed of the upper magnesian. In some instances too, masses or bars of hard compact rock are found in these openings,

pyrites replaces the mineral, and are of limited extent, and need not obstruct the progress of mining. Before attempting to work through them, it would be well to determine their extent by boring, which might be effected with comparatively little expense.

intersected by very thin seams of mineral, and with small points of it disseminated, analogous to the hard blue bars in the upper magnesian. The openings in the upper bed have been worked at Mineral Point and Platteville, north of New Diggings, on the Yellow Stone, and in other localities in the eastern districts. In some instances, these openings have been very productive, particularly at Mineral Point, in the McKnight range, and in Bracken and Murrish's range on the Mineral Point branch, south of the village. Near Platteville, at the Back-bone (a narrow ridge between the Little Platte and the Rountree branch), the occurrence of dice mineral (in the upper bed of the blue limestone) has been long known, and openings in that bed are now worked there to advantage.

The openings in the middle bed of the blue limestone are usually called the glass rock openings. They are situated either in the lower more compact parts of that bed, the upper fine-grained portion overlying them as a cap, and more or less stained of a brown color, as it approaches the opening, or beneath the middle part or proper glass rock, in the lowest division of the bed, adjoining the buff limestone. In the glass rock openings, more variety has been observed than in the pipe-clay openings above mentioned. In some instances, they are dry bone openings; the mineral being accompanied with zinc ores, forming sheets, arranged as in the corresponding instances in the upper magnesian. These sheets are generally quite horizontal, though irregularities in their course are sometimes observed, particularly where crossed by vertical crevices. The same alternations of enlargement and contraction are observed in the sheets, as already noticed; the mineral, in the latter case, being disseminated through the zinc ore mostly in the middle line of the sheet, and in the former, usually forming a distinct middle sheet, and sometimes a geode. These geodes are sometimes occupied in the centre by calcareous spar or sulphate of barytes, or by the two in distinct segregations. At the crossing of vertical crevices, there is usually an increase of the mineral, in larger and more regular forms. In some of those dry-bone openings, the sulphuret of zinc (the original ore) has been very little changed; in others, it has been chiefly converted into the carbonate or silicate (dry bone). The former is the case at Haswell's mine, west of Mineral Point village, and the latter at the Falling Spring mine, south of the village. The cause of such a difference is not very obvious. The finest specimens of the carbonate of zinc yet seen by me, were found in the dry-bone sheets in the openings, in the blue limestone near Mineral Point, particularly at the Irish Diggings. In other instances, the glass rock openings are without zinc ores; the mineral being found under circumstances similar to those under which it is found in the pipe-clay openings. The greater part of the openings in the South Forked-Deer Diggings, on

Wood's branch, are glass rock openings of this character. Only one dry-bone range (Woffal's) occurs in those diggings, parallel in its direction to the other ranges. In these openings, there are usually two courses of mineral; a lower, in a layer of gray shale, similar in its character to the gray shale in the flint openings at New Diggings, in which the mineral is of the same cubic or tabular form and imbedded in the same manner as in the layers of clay in the pipe-clay openings; and an upper, in which the mineral forms a flat sheet, more or less interrupted or broken by interposed clay and calcareous spar. These openings are of great width, but low, and the rock between the courses of mineral is generally hard, which renders it difficult to work them by drifting.

(To be continued.)

ART. IV.—PLANS AND SECTIONS OF MINES.—BY J. BUDGE.

PERSONS who have not had practical experience in mining often acknowledge that they find great difficulty in comprehending the plans and sections of a mine, or of having a true idea of the workings from an inspection of the drawings. This obscurity may be occasioned from an imperfection in the plans; for if they have been executed under a good system, it can hardly fail to exhibit clearly every part of the workings, and, indeed, if the diagrams have not been executed perfectly, and according to rule and order, even miners themselves cannot comprehend them. It requires four distinct mathematical or geometrical drawings to represent a mine, which we will briefly notice under each head; and we may observe, as we pass on, that the common cause of people in general not understanding the plans is because they expect to know too much from one single drawing. Every separate plan exhibits both a true and false view of some parts of the mine; and the knowledge necessary for the observer is, what parts of the workings it is that each drawing furnishes a true delineation of.

With this introduction we proceed to state that the set of drawings may be described thus:—

1. **Ground plan.**
2. **Horizontal or working plan.**
3. **Longitudinal section.**
4. **Transverse section.**

And taking them in the order in which they have been placed, we begin with—

(1.) THE GROUND PLAN.

This is, in the main, a general survey of the whole set, or land granted to the adventurers for the purpose of mining. This plan may be on a scale of three or four chains to an inch; and every lord or landowner's bounds should be distinctly marked on this map.

All the lodes are laid down with their true position and course on this plan, as far as they can be ascertained; and we may remark, that this survey should be made at the outset or plant of a mine, and before any thing has been determined as to the position of an engine shaft, or any other important work, so that the manager may have the benefit of this map, with the lodes, cross courses, and every necessary thing faithfully delineated thereon, to assist his judgment in forming the most judicious arrangement for future operations. For want of this precaution, how often is it that shafts have been sunk in improper places, to the endless disadvantage of the company; and sometimes they have been abandoned and new shafts sunk, at a fearful loss of time and money! In fact, we believe there are but few mines where the conductors have not had cause to regret, ultimately, that they had not taken another position for sinking the principal shafts, and which might have been known, at the outset, if the necessary steps had been pursued.

On this map it should be particularly pointed out if there is any intervening ground on the course of the lodes, that has not been legally granted, so that proper applications may be made in due time, and not leave it until the workings have been commenced, and good discoveries made, and then this landowner, taking advantage of the neglect or oversight, demanding an unreasonable premium and dues for his land, or prohibiting us from driving an inch under it, on pain of knocking us to pieces with the powerful arm of the lord warden of the stanneries.

Among the many inconveniences that have arisen from this cause, I select one that occurred in this neighborhood some eight or nine years ago. A silver mine called Wheal Sisters, in the parish of Calstock, was in full work, and just at the zenith of her glory. Every body concerned with the mine in the shape of London directors, local directors, managers, secretaries, agents, shareholders, &c., thought assuredly (if they ever thought at all) that all the land in the set belonged to the duchy of Cornwall, for no survey such as we have been speaking of had ever been made. But it so turned out, that a field under which the levels had just been driven was *freehold!* And what was the consequence? Why forth came the proprietor in the person of Michael Williams, Esq., of Scorrier House, and says, "Stop!" Well, but she did not stop then; no, she went on faintly, but in an expiring state, after exhausting her resources in paying the

peremptory demand of Mr. Williams. How much was that? Exactly 5000*l.*! Yes, and that gentleman was paid every shilling of it; and I believe not 10*l.* of silver ore was broken in his ground afterward. And let it be known, this enormous sum was for the *dues* only; the little field is still the property of its original owner. This affair is well known, and is calculated to put parties on their guard respecting their mining rights and liabilities. So much for the map of the set or ground plan.

(2.) HORIZONTAL OR WORKING PLAN.

This is the miner's plan, his chart, his guide, his right hand. Whoever attempts to conduct the operations of a mine without a perfect working plan, is unfit for his office. The very circumstance of his supposing himself capable of doing so, is a certain proof of his ignorance.

This plan gives what surveyors call, "a bird's eye view" of the mine; or let us suppose that the ground was transparent, and by walking over every part at the surface we could look down and distinctly see all the workings.

A person who never saw a mine will understand from this view that he could distinguish the course of the levels in all their turns and windings, and, as respects all the "horizontal" drivings, he would have a *true* view of them; but these drivings are the *only* thing that he would obtain a true view of in this plan.

Keeping his position in view, he hardly requires to be told, that he can only see the brace or mouth or base of all the vertical or downright shafts, even if they were 200 fathoms deep.

As for the diagonal shafts or winzes (which are small ventilating shafts sunk on the declination of the lode from level to level), he would only see the "underlay" of them, or the distance that they diverge from a perpendicular line. As lodes, almost if not altogether without an exception, have a dip or declination, called by miners "underlay," it follows that the levels are generally removed away from the vertical line, and not concealed one by another, although this is sometimes partially the case when there is a reverse or change of underlay. In addressing myself to the miner, in reply to his question or inquiry respecting the best method of constructing and keeping up a working plan, I will endeavor to explain the system I always adopt, and which I believe is the best, at least I have found it so, after thirty years' experience. Let the scale be five fathoms to an inch. Before you begin to lay down any part of the workings, draw faint lines throughout the whole length and breadth of your sheet of drawing paper at right angles, forming two inch squares; these lines will be your cardinal points. If your lode bears east and west, the longest way of the paper will of course be appropriated for that bearing. These lines are always to remain; and as they are to be single, and fine, and the course of your levels drawn with

double lines, they will not in the least confuse, especially as your levels must be distinctly and variously colored between the double lines (which represent the breadth of the level), so that every level, with all its drifts and connections, may be distinguished in a moment or two, however numerous or complicated your levels and drivings may be. One grand advantage of these cardinal cross lines is, that every intersection forms a proper and suitable point for laying on the centre of the double-limb protractor, or any other, on all occasions, so that in keeping up the plan or laying down any additional drafts, there is always a point close at hand for the protractor, without the inconvenience and risk of bringing on a north and south line, for the purpose, from a distant part of the paper. Another convenience of these lines is, that the bearing of the lode, or any part of it, may, by their help, be obtained in a few seconds; for instance, as every side of one of the squares gives 10 fathoms, when a level has been laid down, we can, by inspection, see very nearly (and by the application of a scale exactly) what it has diverged to the right or left from the main course, and if we find it to be (say) 125 fathoms east, and 19½ fathoms north, the tables will tell us that the bearing is 8° 50 north of east; and, by the same means, we may always check or prove the truth of the plan or the construction by trigonometrical computation, and which should always be done before the plan is relied on, or pronounced perfect.

This plan, proved and well kept up, becomes invaluable to the mine agent. Does he want to sink a winze in one level and rise against it in another? Every thing he can wish for is before his eyes. The two corresponding points for the sink and rise, the amount of underlay, the bearing, the length of the winze and its vertical depth, are all embodied in the plan. Has the lode split, and have the workmen driven on the wrong bench? look at the plan, and compare notes with the general bearings, and the course to be adopted will be apparent. I have known a case where the plan betokened that a misdriving had taken place in a level, but the agent persisted that the driving was right in spite of the plan; however, the manager, having more confidence in *computation* than in *conceit*, was convinced by the indications of the plan that they were gone off the main branch, and ordered them immediately to "turn house," or cut north at right angles: this was done, and in driving two fathoms, the main lode was discovered with a large and rich course of copper ore.

(3.) LONGITUDINAL SECTION.

This drawing supposes that a section of the ground has been cut away, and that a side view of the mine exposed. If it is an east and west run, the observer is placed at the south of the mine, and taking a panoramic north view of all the excavations.

In this position he will have a perfect sight of all the vertical shafts, and a general view of the stopes, or ore ground broken away between the levels, also the dip of the courses or ore may be portrayed and distinguished, and the surface line of the country, with a perspective view of the buildings and machinery, may be seen or exhibited fairly by this section. But the levels, diagonal shafts, cross-cuts, and winzes, will have a false or imperfect appearance here. For instance, the levels will *appear* to be perfectly straight, however serpentine or crooked their course may be. The diagonal shafts and winzes will appear to be perpendicular, because their dip is in the line of the inspector's eye; and as an *end* view will be taken of the north and south cross-cuts, the extent of these drivings will not be seen.

The only real benefit of this section to the miner is, that it may be so contrived as to show the dip, or inclination, or declination, of the bunches or courses of ore, and this circumstance he may turn greatly to his advantage in working the mine. For example, suppose in driving the 50 fathom level, going east, we cut into a course of ore, and it lasted 25 fathoms in length; let these two points of the "coming in" and "going out" of the course of ore be correctly marked in this 50 fathom level of this section.

In the 60 fathom level, or next level below, the same course of ore was cut 4 fathoms farther west than it was in the 50, and the course of ore at this level proved to be 28 fathoms long. Let these points also be marked on the section, and as there is a general regularity in the dip of ores, the agent is now in possession of a clue, whereby he may form a reasonable judgment at what place the course of ore will come in at the 70 fathom level, or levels still deeper, and also at what point it will fail in driving east, hence he will be better qualified for setting tribute with the help of this section than if he had no such guide. The longitudinal sketches that are usually shown in mines, with a pell-mell blotch of the stopes, and, as we have shown, the false view of the levels, diagonals, and winzes, are useless to the miner, and deceptive to the stranger.

(4.) TRANSVERSE SECTION.

Here the view is taken at one end of the workings. Suppose again the drivings to be east and west, and the dip of the lode northerly, the observer is placed at the west end, with his face easterly. Now, for the first time, he will have a fair view of the declination of the shafts and winzes that have been sunk on the course of the lode, and thereby he will see all the dip and variations of the lode from the surface to the bottom of the mine. Here he will see the northing and southing made by the cross-cuts, and if a vertical shaft is in sinking to take the lode at a certain depth, the point of intersection will be apparent to his

view. Respecting the levels driven on the course of the lode, he will only see their western end. If there has been no diagonal shaft, but the mine has been worked by a downright sump or engine-shaft, this section will exhibit a regular and correct view of all the drifts or cross-cuts, from the shaft to the lode, and from this date, or the extreme ends of the cross-cuts, the declination of the lode will be conspicuous. The transverse view of the surface line will finish all that can be fairly seen by this drawing.

OBSERVATIONS.

After such a detail we think there will be no occasion for "summing up," or repeating to the inquisitive stranger, or adventurer, what may be seen, and what may not be seen, on each and every drawing. To the practical man, or with him, we may converse of the best and readiest means of making these drawings. Let us suppose the horizontal or working plan to be drawn and executed, and proved in a correct and masterly manner, and all the vertical shafts truly *dropped* or measured. We are then in possession of every thing necessary for drawing the two sections without going out of the office; for by parallels, or a drawing board and slides, all the shafts, winzes, &c., may be transferred from the plan to the paper prepared for the sections, with despatch and accuracy. True, we may have recourse to the dialling book for the position, length, height, and depth of the stopes and sinks; and if a perspective drawing of that part of the set where the buildings are placed should be required, a sketch must be made for that purpose.

To the learner we would observe, that, if he is about to survey a mine and draw a working plan, let him lay down his shallow adit, or the upper levels, first, and the others in succession; because, wherever any *crossings* take place, or one level or draft passes immediately under another, the upper level must be entire or unbroken, and the under level will not be shown, as a matter of course, being necessarily obscured or concealed by that part of the workings that passes immediately above it. One method of proving his work as he proceeds is as follows:—Suppose he has surveyed the adit level, and there are four winzes communicating with the 10 fathom level, and he has taken the bearing, and depression, and length of those winzes, and plotted or laid down this level and the true base of those winzes on his working plan. He then proceeds to survey the 10 fathom level, making good every thing as he proceeds; and of course when he arrives at the foot of those winzes which he surveyed in the adit, he minutely enters in his dialling book the mark at their foot, where he took his diagonal observation and measurement. Then in laying down his 10 fathom level, if all his work has been well done, the points in those winzes will exactly correspond with his

survey in the 10 fathom level and on the plan, and this desirable check he may and should pursue throughout the whole survey. It is too common in these cases, in order to avoid the time and labor in surveying the winzes, to "let them take their chance," by merely entering their "brace" in one level and "foot" in another, and let the truth of their respective bearings and underlay depend on the horizontal survey of the levels. This practice is reprehensible, and should never be tolerated. But with all this precaution, we advise by all means, that every part of the plan be proved by trigonometrical computation, and the surveys by fore and back diallings. Let us suppose we have surveyed a level by double diallings. How shall we ascertain if there is a perfect correspondence? We have introduced a problem on this subject, and it is plain that the final two sums of the traverse will demonstrate either the agreement or the difference. This being done, and the underground work proved correct, we proceed to construct or draw the level on the plan, and it is most desirable that we should know if this part of the work has been well executed; and as we have computed the workings, we are furnished with a ready and certain test. Suppose we found, by computation, that the level gave, beginning to end, 184 fathoms 3 feet of southing, and 34 fathoms 4 feet of westing. Now, applying these numbers to the plan, we shall, by the convenient help of the cardinal lines and instruments, presently prove if the latitude and longitude between the start and terminus of the level on the plan make good these lines. Lastly, I would recommend that the instruments for drawing and keeping up the working plan should be a 6 or 7 inch circular protractor, on the best principle, with double limb and vernier scale for reading off the angle, so that there may be no *guessing*, or judging by the eye, merely, for the fractional part of the degree; also, a parallel ruler of the best kind. I prefer those rulers that travel on rollers, both for expedition and accuracy, but I admit it requires some practice to use them well. There is an advantage in those rulers, in that they have an ivory edge and a graduated scale, so that the lengths may be pointed off at the same time that the line is drawn, without using a compass or dividers; and these two instruments are all that are required for the drawing department. The parallel ruler should be a foot long, divided into thirty feet to an inch; so that any line within the extent of 360 feet can be pointed off at once.

Art. V.—THE IRON TRADE OF GREAT BRITAIN FROM 1830 TO THE PRESENT TIME.*

The period from 1830 to the present time, embraces some of the most important improvements in the manufacture of iron, and exhibits a more surprising growth in its trade than all former years. The improvements were chiefly made in the earlier part of this time, and many are now familiarly known and generally in use. There is a degree of interest attached to their history, which should not, therefore, be confined to a mere mention of them.

In 1830, the English Iron Trade had attained such a degree of importance, as caused both theory and practice to be brought in play, to discover the best means for improving the quantity and the quality of the iron. The blast furnace, therefore, underwent almost every variety of form, with the exception of those which have been found most beneficial in the present day. Some of these changes are worthy of mention.

The old charcoal furnaces, from 12 to 18 feet high, or where a good water power existed, even 28 feet, gave place to coke furnaces of 40, 50, 60, and even, in one instance, 70 feet, of which height a furnace was erected in South Wales, but, after in vain attempting to work it, they were obliged to reduce it, which they did to the extent of 30 feet, by cutting a hole in the side, narrowing the mouth, and throwing in the materials at 40 feet instead of 70. The width of the boshes also varied from 10 to 15 feet; and an experiment was tried at Muirkirk, in Scotland, where they reduced the width of the boshes from 10 feet to 8; the height of the furnace being 40 feet: but it was soon found that with the same volume of blast, which was formerly applied to the ten-feet furnace, very inferior effects were now produced. The combustion, apparently, was carried to too great an extent, and the materials, owing to this circumstance, entered into fusion before the iron had imbibed a sufficient dose of the coally principle from the fuel. Another great evil which resulted from this diminution of diameter, was a friction, or retardation of the descent of the materials upon the lining of the furnace. This evil was increased, and the materials made more buoyant, by the usual volume of air elevating itself in a cone not much more than half its former area. The consequences were, that the whole mixture of coke, ironstone and limestone, would frequently hang for an hour together, or until the blast had cleared the hearth and boshes of materials, a slip would then ensue, and bring with it a large proportion of newly-introduced matter. The introduction of this into the fusing point, before being properly heated, and long before any affinity had been established betwixt the particles of metal and the carbon of

* History of the Iron trade, from the earliest records to the present period. By Harry Scrivenor. London, 1855.

the furnace, invariably changed the quality of the metal, and caused frequent and sudden alterations from gray to white iron. But the general average height and width of the furnaces, about thirty years back, may be taken at 40 feet from the upper surface of the hearth bottom, 11 feet across the boshes, and $3\frac{1}{2}$ feet for the diameter of the tunnel head, or furnace mouth. Till that time it had been the custom to blow the furnace with one tuyere; they now, however, at some works began to blow with two, and the beneficial effects being soon experienced, they became very generally introduced. No material alteration took place for some years, when accident in some degree discovered what now constitutes one of our greatest improvements. One of the Blendare furnaces, near Pontypool, built as usual, with a narrow top, carrying but little burden, and making neither quantity nor quality, by some chance gave way in the top, so far as to widen the filling place to 9 or 10 feet. This accident was immediately followed by a cooler top, a better quality of iron, and a greater weekly quantity; and this accidental alteration furnished a model for the construction of other furnaces at the same works. Changes of this kind are not brought about rapidly, by reasoning or knowledge of principle, but by a series of slow observations and chance circumstances. The subject is, however, now better understood, and within the last five or six years the mouth or filling place of the furnace has been very generally enlarged; and, instead of 3, $3\frac{1}{2}$, or 4 feet, are now from 8 to 11 feet, and in some few instances larger.

One of the most striking varieties in the modern form of the furnace, and from which the greatest quantities of iron have been run, is the cylindrical form. Furnaces of this description were erected in many places, and amongst others at the Govan Works, in Scotland, of which the following is an account of a fortnight's work:—

No. 1. Furnace,—15 feet 8 inches in diameter, 45 feet high, cylindrical, from the boshes to within a few feet of the charging plate, where it is rapidly brought in to a convenient diameter for the tunnel head. Blown on 21st November, 1840.

Two weeks, ending December 12th, produced—

1st week 140 tons 1 cwt.	No. 1.	1st week
2nd " 145 " 6 "	iron.	stopped 12 hours.

Blown with hot air, and 5 tuyeres, pillar of blast—3lbs. per square inch, at tuyere pipes.

No. 2. Furnace,—15 feet diameter, cylindrical, 45 feet high.

1st week 128 tons 15 cwt.	stopped 12 hours,
2nd do. 150 " 11 "	No. 1. iron.

No. 3. Furnace,—Out of blast, being enlarged.

No. 4. Furnace,—11 feet diameter, 45 feet high, and cylindrical:—

1st week 75 tons 2nd do. 77 " 13 cwt.	stopped 12 hours, No. 4. iron.

No. 5. Furnace,—15 feet diameter, 45 feet high, and cylindrical:—

1st week 95 tons 2nd do. 116 " 13 cwt.	No. 4 iron, stopped 12 hours.

In pursuing a brief notice of these improvements, during the last thirty years, the author, whose volume is noticed in the outset of this article, furnishes some interesting statements—

The boldest and most successful alteration in the form of the blast furnace was made by Mr. John Gibbons, of Corbyn's Hall. The account of his furnace was published by himself in a small pamphlet, and circulated amongst his friends. Mr. Gibbons' furnace is considered the best in Staffordshire, for the duration of the hearth and boshes, working to good yields, making good iron, and greatest quantity. The duration of the hearth and boshes appears to arise from the fact of the hearth being put in wider than they generally are, and consequently giving more room for the blast to act. The boshes commence a little above the tuyeres, and have nearly the same inclination as the curve of the furnace; the boshes, in fact, running 30 feet high; at which height is the widest part of the furnace, it being there 14 feet. Mr. Gibbons, an eminent ironmaster, a gentleman having ample opportunities of watching the blast furnace in its operations, observes, that he acquired the habit of observing with much attentive interest the changes effected by the fire in its inner form; his attention was first more particularly directed to the very rapid destruction that takes place in the hearth and boshes during the early period of the furnace being worked: "at the end of six months it may, I believe, be safely stated as a general fact, that both of them have been carried away to the extent of at least a third of their substance. From this time, or about this time (for exact accuracy cannot be obtained on such a subject), the destruction becomes gradual, and proceeds more or less slowly, till the boshes, either in some part of their circle, or the whole of it, are obliterated; and this may be called the natural death of the furnace—it will carry on its operations no longer." "The hearth may be replaced or repaired from without for an indefinite period, but the boshes are beyond our reach, and when they are gone, the case is hopeless—the furnace must be blown out." Mr. Gibbons' observations extend in the second place to the upper part of the furnace. He states, that it appeared to him, if he at once *made* the room which the furnace *makes* for itself by a rougher operation, "I might probably preserve thereby a considerable portion of my hearth and boshes. I put in my hearth stones as wide asunder as the pillars of the stack would allow; I cut them upwards from the tuyeres to their junction with the boshes in a diagonal line, so as to bring them into the same, or nearly the same angle with the boshes, and I certainly found that my purpose was thus far answered.* The furnace lasted longer, the hearth did not call for repairs so soon; and there was this additional advantage, I arrived at my full burden and average make for months before the accustomed period." The second alteration Mr. Gibbons considers of even more importance:—From the appearance of the liming bricks, it was evident that in the old form of furnace, the heat in the upper part had little intensity, the fire-bricks were barely glazed. With the view, therefore, of accumulating heat in this hitherto useless part, instead of building the interior of his furnace in a straight diagonal,

* Till this time the hearth stones were put in, forming a square of 2¼ to 2½ feet at the bottom, and running up about 7 or 8 feet; and even to the present day there is a prejudice that the fire had better form its own hearth, but Mr. Gibbons very justly observes, "If the stones *melted*, it would be true to the full extent; but they do not *melt*, they *shatter*, and detach themselves in fragments of irregular shape and size, according to their natural clefts or fissures. If he were to build a new stack, he would place the pillars wide enough asunder to admit a five-feet hearth."

or nearly so, from the top of the boshes to the filling hole, or tunnel head, "I *scooped* it outwards, so far as I could do so with safety to its structure; this gave me much room upward, the effect was unequivocal, particularly in my yield of coal." He next increased the diameter of the tunnel head, of which he considers that eight feet will be found the proper maximum, and in that case there must be, at least, four filling holes.

"Instead of beginning to contract the interior from the usual termination of the boshes (about twelve or fourteen feet from the bottom of the hearth), I have kept widening it upwards to the height of thirty feet (more than one half of its total height), so that my boshes being twelve feet across, the widest part of my furnace, which becomes virtually the crown of my boshes, is full fourteen feet."

By which he attained the great object of removing the boshes from the action of the fire, by giving to their plane a deeper slope, and *much* greater elevation.

Mr. Gibbons states his six months' make as averaging 100 tons per week. His best three months' work, 107 tons per week; and his best week's work 115 tons, which shows an extraordinary regularity in the working of his furnace: this is the great point to be desired, especially where good and uniform quality is required. The make "was always good gray forge-pigs."

Mr. Gibbons presses on the attention two circumstances which operate against his make; the first is the use of cinder, the second is an insufficient supply of blast, its density being only 1 lb. 13 oz. per inch, and its volume not adequate to the necessities of a common-sized furnace. The largest blast furnaces in South Wales are those of the Plymouth iron works at Duffryn, near Merthyr, 18 feet diameter in the boshes, and 9 or 10 feet at the filling place, the height 40 feet: so that their capacity is equal to at least 7,000 cubic feet, and when at work each of them must contain at least 150 tons of ignited materials for iron smelting. There are three of these enormous furnaces into which are discharged per minute at least 20,000 cubic feet of atmospheric air, under a pressure of 1½ lb. to the square inch. This is below the general pressure in South Wales, which may be taken at 2½ lbs. on the inch; these furnaces, however, thus blown, frequently make 120 tons each weekly.

We cannot but be struck with this extraordinary increase in the make of a furnace, to which various causes have conduced—larger and better-formed furnaces, improved blast, and also superior knowledge in the preparation of the materials, application of the blast, and working of the furnaces. It has been observed, that some of the furnaces which make the best work as to quality and yield, in Staffordshire, do not exceed 11 ft. 6 in. or 12 feet in the boshes. Where quality is an essential, a furnace of this size is more to be depended upon than the very large ones. All furnaces require unremitting attention on the part of the manager; and even with this attention, aided by superior knowledge, the furnace will, owing to the great difficulty there is with some materials, occasionally get out of order, in which case a change is sooner brought through in a small furnace than a large one—it is more manageable.

The next step in the progress of improvement was in the process of puddling.

This process, although so beneficial in itself, was nevertheless attended with a waste of about 20 cwt. of pigs to a ton of bars, or in other words, it took two tons of pigs to make one ton of bars; and for some years afterwards it required 30 to 35 cwt., even when the process became much better known; at the present time the waste does not generally exceed from 6 to 7 cwt. of pigs to a ton of bars, including the waste in the refinery.

The principal improvement in the puddling is the substitution

of iron for sand-bottoms in the furnaces. At the time when the sand-bottoms were used, the puddlers seldom charged more than $2\frac{1}{2}$ cwt. of metal, and could not work more than four heats in the twelve hours; the principal cause of delay arose from the puddler having to make a fresh bottom each time before he charged. Neither could they puddle pig-iron alone, in consequence of its boiling and getting mixed with the sand; the waste also was considerably more in this process than in any other mode of working.

They then tried another plan with a large metal basin to work pig; but they did not succeed, the pig melted so raw and liquid, it fastened to the edge of the basin, and could not be got off by the puddler. Iron bottoms were then substituted, and are now very generally used.

In some works they puddled all pig by a process called boiling, originating in the impression that the waste in the refinery might in a great measure be saved.

In Puddling Refined Metal.—The metal is first put in the furnace and melted: when melted, a small quantity of hammer-slag is added to ferment it, and discharge the impurities of the iron; it is then worked by the puddler till it is in a sufficient state to be dried; the damper is put down, and the iron dried, after which the damper is raised up and fresh coals put on, and the iron is puddled till it is ready to ball and be taken to the hammer.

Time melting	25	minutes.
From melting till dry	15	"
From being dried till shingled . . .	30	"
	70	"

Time lost in cleaning grate, charging furnace, &c., about 90 minutes in the course of twelve hours. 8 heats of $3\frac{3}{4}$ cwt. may be worked in the 12 hours.

In Boiling Pig-iron.—Before the charge is put in the furnace, a sufficient quantity of hammer-slag is put in, and then the pig-iron. Fresh coal is put on to melt the pig and hammer-slag. When it begins to melt, the puddler commences working it, and the more he works it, the more it boils and the purer it is. If the iron is of good quality, it will boil for thirty or thirty-five minutes from the time it is melted. When done boiling, the cinder, which has been floating on the top of the iron, drops through it on to the plate, leaving the iron to be worked up, till by working it becomes malleable, and fit for balling. After the iron is taken to the hammer, the cinder is drawn from the furnace, and fresh hammer-slag used for the next heat.

Time melting . .	25	minutes.
Time boiling . .	35	"
Worked into a malleable state	55	"
	115	"

[To be continued].

JOURNAL OF MINING LAWS AND REGULATIONS.

FALSE REPRESENTATIONS.

This was an action on the case, in which the plaintiff sought to recover damages from the defendant on two distinct grounds—the first for breach of an alleged special contract; the second in respect of an alleged false representation, in the nature of a deceit. This case presents two distinct aspects: and, as the decision was different on each, we shall endeavor to distinguish them, so as to put our readers fully in possession of the case in its several bearings. It appeared that the defendant, with several other persons, whose names were not disclosed, had agreed together to form, and had in effect formed, a company upon the principle known as a Sociètè Anonyme, or, in other words, probably on the Cost-Book Principle, to be called "The Iberian Silver-Lead Ore Company," for the purpose of smelting and refining the ores of certain mines in the kingdom of Spain. The defendant was one of the original promoters, and a managing director of the company, and a prospectus was got up and issued, in which it was stated that the company was to be divided into 96,000 shares of 1*l.* per share, out of which 12,000 shares were to be appropriated to the public at 12s. 6d. per share, free from all further calls. It was alleged that the plaintiff, as such managing director, had, by the prospectus and public advertisements, promised and in effect guaranteed, to the holders of the 12,000 shares at 12s. 6d. each a minimum annual dividend of 33*l.* per cent., payable in half-yearly dividends of 16*l.* 10s. per cent.; and further, that such dividend should be payable until the 12s. 6d. per share should be repaid to each of the holders of the 12,000 shares, the first half-yearly dividend to be payable on the 24th of December following. The action was now brought in the first place, on the alleged special contract, to recover from the defendant dividends at the rate of 33*l.* 10s. per cent. on certain shares, which the plaintiff alleged he had bought on the faith of that promise and guarantee. In case, however, the plaintiff failed in that view, it was then brought to recover damages from the defendant for having, by false promises and representations, induced the plaintiff to become the purchaser of a certain number of those shares. The first count averred that the plaintiff, relying on the promise and guarantee contained in the prospectus, had become the purchaser of 2,500 shares at 12s. 6d. per share; that the time for paying the half-yearly dividends of 16*l.* 10s. had elapsed; that the defendant had not paid them according to his guarantee; and that they were due. To this the defendant demurred generally, thereby insisting that admitting all the facts as stated to be true, still there was no valid contract or ground of action. The Court, after full argument, held, this count being framed on a breach of contract, that unless it disclosed a valid contract, that branch of the action could not be maintained. This count did not allege that the shares were transferable, and it laid the promise as made to the bearers of the shares, and did not allege any promise to persons who should thereafter become purchasers of the shares from others, within which class the plaintiff came. They, therefore, held that there was a total absence of consideration for the promise or guarantee; for it was not alleged that any benefit accrued to the defendant from the plaintiff having purchased the shares, or that, at the time when the promise was alleged to have been made, any prejudice accrued to the plaintiff. Holding, therefore, that there was no original connection, or, in the law term, privity, between the plaintiff and defendant, and also that there was no sufficient consideration nor promise to constitute a valid contract, judgment was given on the first count for the defendant. As the Court came to a different conclusion on the second count, it is essential distinctly to understand how the false representation or deceit was alleged. After stating the prospectus as we have explained it, the plaintiff alleged that

the defendant, by means of a false, fraudulent, and deceitful representation, induced the plaintiff to become the purchaser of the 2,500 shares, and that, by means of such representation, the plaintiff was induced to pay his money for the shares, the representation being false and fraudulent, to the knowledge of the defendant when he made it. The plaintiff further alleged, that the defendant had no ground for offering such guarantee, as he well knew when he offered it, and that, by reason of such false representation, the plaintiff was likely to lose his money. By demurring generally to this count of the declaration also, the defendant admitted the facts as stated to be true, a general demurrer to a pleading at law being as much as to say, admitting all your charges to be true as you alleged them, you have no legal cause of action against me, leaving the Court to decide simply upon the law of the case, whether the facts, as disclosed and admitted, constitute a legal ground of action. The Court decided that this branch of the action was founded on a deceitful representation, and not on a contract, and they laid it down as settled law, that if A makes a representation which is false, and which he knows to be false, to B, meaning that B should act upon it, and B, believing it to be true, does act upon it, and thereby sustains damages, B may maintain an action on the case against A for deceit, there being the conjunction of wrong and loss, entitling the injured party to compensation in damages. Had it been alleged that the defendant, meaning to deceive the plaintiff, and to induce him to purchase shares in the company, under the belief that it was a safe and profitable undertaking, fraudulently delivered to the plaintiff the prospectus containing the false representation, which the defendant then knew to be false, whereby the plaintiff was induced to purchase the shares at the full price, which shares were of no value whatever, whereby he lost the price he paid for them, there could be no doubt that such a count would have been sufficient. The Court were unanimously of opinion that the allegations in this case were in effect, equivalent. The defendant's counsel had argued that there was not a sufficient allegation of a false pretence; but the Court decided that the statement of the guarantee in effect being that the defendant, knowing the company to be a bubble company, fraudulently pretended to guarantee the dividends, so as to induce persons to purchase the shares of a company in which he was promoter and director, knowing at the time that there was no ground for offering such guarantee, was amply sufficient. They further held, this ground of action being wholly irrespective of contract, and founded entirely upon the false representation, that for the purpose of inducing the plaintiff to act upon it, privity or connection between the parties was wholly immaterial, and that, although the parties were entire strangers to each other, the action lay. Judgment was, therefore, given for the defendant on the first branch of the case, and for the plaintiff on the second, whose damages will now have to be assessed by a Jury.

Our very numerous readers, connected as they are with companies, mines, and shares, will at once see the vast importance of the principles which this case established. We are conscious that sanguine men are often in the habit of exaggerating anticipated advantages, and it is certainly not going too far when when we say, that the decision in this cause ought to render projectors cautious and circumspect in not holding out extravagant prospectuses, when conscious what they promise cannot be realized. The principles laid down would also seem to apply to too flattering reports; but it is important to bear in mind, that the very essence of such a ground of action is deceit, and in deceit the following ingredients are essential:—First, that the party must state what is false, knowing it at the time to be false; and next, that he must state it fraudulently and with an intention to deceive. Before the party aggrieved can complain, he must show that he was actually induced to invest the money by the representation which proved false. Our readers are well aware that the great majority of shares are not usually purchased on the faith of such representations; that they are far more often bought in a buoyant market, in the hope of speculative profits; and that the allegation requisite in order successfully to sustain an action for deceit, can in very rare instances be sustained by direct, evidence. This case

having been decided on demurrer, we have before explained that the allegations which were material—indeed, essential—to the sustainment of the action, were all admitted. If the defendant here had pleaded, instead of defending himself on a legal and technical objection, the plaintiff would have had to prove every one of those distinct allegations to the satisfaction of a jury. He would have been bound to establish that the representation was false; that the defendant knew it was false when he made it; that he made it in order to induce parties to purchase; that the party complaining purchased on the faith of it; and that his money was in peril by reason of the fraud. We have thus presented this case to our readers in every possible phase. The principles of law decided are highly important: they are here elucidated in such a manner that parties can apply them to their own individual cases; and our explanations will, we hope, tend to satisfy our friends that, although the decision was at first sight startling, the propositions affirmed by the Court are not altogether so alarming as persons might at first reading the report have imagined.—*London Journal.*

COMMERCIAL ASPECT OF THE MINING INTEREST.

NEW YORK, *September 10th*, 1855.

The now long-continued ease of the money market does not improve materially the commercial aspect of the mining stocks. This is owing to the want of confidence; which cannot b erecovered but slowly, and after a long period. The mining wealth of the country is however of extreme value, and requires much labor and capital for even a partial development.

The transactions at the mining board are unimportant. The sales seem confined to the stock of the Aberdeen Company, Gardiner Gold Company and Ward Coal Company. This last-named company is of dubious character. The stock has been placed on the board at one dollar per share, and transactions are reported \$1¼ on time. The par value is stated at \$5 per share. In a pamphlet put forth by the Company, the resources it claims include a number of shares valued at five dollars per share, while the selling price is only one; but at this false estimate of the value, the resources are made only sufficient to cover a bonded indebtedness already incurred, though the Company is in its incipiency. It has the air of a Parker Vein affair, and parties before they deal in it, should look narrowly into the merits or demerits of the enterprise; which is one that seems to look to Wall Street mainly for support.

The liabilities are stated at \$54,900, bearing interest at 5 per cent. The resources are—

Property at mines cost	\$7,000
Patent rights for brick machines valued at	6,000
Money due on demand and contracts	11,000
29,975 unsold shares of stock at market value of \$1.	29,975
	\$53,975
which deduct from liabilities	54,900
leaves deficiency, (besides running interest on \$54,900).	925.

The Cannel Coal Company of Coal River, Virginia, whose mining property is situated in Boon and Kanawha Counties, Virginia, comprises 7,300 acres of land held in fee simple. Of these 5,000 are on Big Coal River, forty miles distant from its mouth, and the remaining 2,300, about 20 miles nearer. The Company have a stock capital of $1,500,000, divided into 60,000 shares of $25 each. Of these 46,000 shares have been sold, 10,000 are now being offered for sale, and the remaining 4000 are held in trust. The Company have already expended over $200,000 in developing the property, and the shares now offered are with a view to raise additional working capital, there being no floating debt to discharge. The land contains both cannel coal and splint coal suitable for steamboats and manufactory purposes. It has a river frontage of five miles, and the mines open directly upon the river, 200 miles from Cincinnati, to which they are nearer by 225 miles from Pittsburgh, the previous chief source of supply for the market of Cincinnati. The company already send coal to market largely, about ten thousand bushels daily, and is on the increase.

The Coal River and Kanawha Mining Company is out of debt, has only 20,000 shares, at $50 per share, making its reputed capital $1,000,000. This Company is about to erect works on its coal estate for extracting oil from its coal, which it expects to find its most profitable employment.

The Stock of the old Reading Railroad Company is still the most prosperous, commanding large transactions at 94 to 95 per cent. The coal it sends to market employs all its railroad force, and never was so great in quantity as it has been this season. The successful finanical operation of converting bonds into stock, proves the increasing estimate of its worth. There was a time when the stock of the Delaware and Hudson Railroad Company fluctuated as widely and as greatly as that of the Reading has done. Its stock is now above fluctuations, from the great solidity of the Company. Reading is fast assuming the same character. Time, under the present able directional management, will insure this.

The Stock of the Cumberland Coal Company continues steady at 27 to 28 per cent. There is diminished speculation in this stock, with improving confidence in its present position.

The old Lake Superior Copper Companies are doing a large business. The receipts of copper are very large, yet but very few of the new Companies that have been started have been as yet successful. The Fulton Copper which promised so much seems at a stand. The New York Mining Company of Lake Superior reports no progress. The Cliff and the Minnesota are very prosperous; and the Isle Royale, Portage, and one or two others promise well. Bohemia seems in a dead lock, and the stocks of the American Mining Company, namely, Norwich, Windsor, &c., are of very uncertain character.

The Gold Mines of Virginia and North Carolina do not make the much promised progress. The only reliable Gold Mines are those of California.

The auriferous streams there are more abundant than ever in the gold dust they yield; but difficulty is still felt from the want of perfect and cheap methods to crush quartz rocks. Mr. Herman Gardiner has invented a new machine for this purpose, which is to crush, pulverize, and amalgamate the pulverized ore by the same revolutions under the steam power. It consists

of a large bowl or kettle, with a ball in it, which crushes or breaks into pieces the gold quartz; which pieces roll into force mills of the old Chilian pattern, which mills are immersed in tubs filled with mercury; and the whole machinery is made to turn rapidly by a nine-horse Steam Engine, and as the pulverized ore mixes with the quicksilver, it is collected by tubes into receivers. The whole machine is fixed in mason work, for strength and security.

The patent has been bought by a Company called the American Mill Mining Manufactoring Company, having an office at No. 11 Pine Street.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

We have been favored with a copy of Prof. Trask's Report to the Legislature of California during the last session, and which is a continuation of his previous report. It contains some further particulars relative to the progress of some of the Quartz Companies in the interval between the reports, and later than is to be found on page 180, etc., Vol. III. of this Magazine.

Lafayette and Helvetia Mine.—This mine is located in Grass Valley, and the diagram of their workings is taken from the lode on Lafayette Hill, one and a half miles south-west of the town. In this mine is found a heavy east and west vein, having a dip of about thirty-eight degrees, with a power of four feet at eight fathoms. The lodes of this hill have been fairly opened, and thus far present a somewhat envious feature to neighbors. The present depth of the workings are about eleven fathoms at the deepest point, the lode in the greenstone, with the above power and a tendency to advance from the latter. The underlie of the vein for about one hundred feet and immediately adjoining the walls, is a bed of hydrosilicate of magnesia of an extremely fine texture, containing gold. And the adit level of the mine, exclusive of the team-road for conveying the cattle to the mine-yard, is in its total length 1,200 feet. Not increased from last year, it will be seen, in consequence of the change in the course in which they have been driving during the past year on the east and west lode. The working on the latter is near one hundred and forty feet, and thus far proved a fine quality of ore.

During the past season the company have erected a new mill directly upon the last lode. This is a most judicious movement on their part, as it will be the means of saving the neat sum of eleven thousand dollars each year which has been heretofore paid out for teaming. The arsenical ores do not increase much from last year, and the sulphuret of iron containing and investing the metal, is more abundant than formerly. The reduction works are carried by a twenty-five horse-engine, with a double battery of nine stamps each, and when in full operation is capable of reducing about thirty tons of ore per day. This mine employs twelve miners on the lode, day and night, while the aggregate of the other laborers amounts to twelve more; making a total of twenty-four.

The use of Cram's cylinder and Berdan's amalgamating apparatus, have been thrown aside as of little use, and inferior to the more simple and far less expensive methods that have been suggested from practical experience in this district.

Osborn Hill Mine.—This mine is located two miles east of Grass Valley, on the above hill, and the Lawrence Hill adjacent. Vein has a strike north and south, with an easterly dip of forty degrees. The workings of 1853 have been abandoned for the purpose of attacking the lode at a lower point, some six hundred feet to the north of the latter, and thus drain the southern part of the lode. This has been accomplished by the sinking of their water-shaft to the depth of one hundred and sixteen feet, and which is fifty-one feet deeper than their former shafts of the old workings, and cuts the lode about 80 feet below the greatest depth reached at any former period. The amount of levels driven on Osborn Hill, and principally south of the deep shaft, exclusive of the extreme south workings, is four hundred and fifty feet, and upon Lawrence Hill three hundred feet; making a total of seven hundred and fifty feet, thus exposing a heavy bed of good ore. The amount of shafting on both hills is near that of the levels; the mine is thus well ventilated. The power of the vein is three and one half feet, at the depth of twenty feet into the solid greenstone. Arsenical pyrites are plentiful among the ores of this mine. The full complement of laborers at this mine engaged in the lode, is thirty-two.

Empire Mine.—Situated in Grass Valley, near the southern extremity of the town. This mine has been in active operation for two years, and their works have been uninterrupted during the greater part of that time.

Their principal lode is situated at Ophir Hill, one and a half miles to the east of their reduction works. The superior portion of the lode is situated in a decomposed granitic rock, and enters the greenstone at the depth of 108 feet, at the engine shaft A. The accompanying diagram* is a general plan of their tower workings, which is on a level with the bottom of the above shaft. The entire lode is very much decomposed, and the quartz matrix heavily charged with peroxide of iron; it is very seldom that gold is easily discoverable with the naked eye in any of the ores from this hill, yet is found to yield remarkably high in the reducing process. At the main shaft, A, is an eight inch lifting-pump, driven by steam to free the mine from water, and also for bringing ores to the surface from level, B, and gallery, C, the same being conveyed from the latter down to the level through the winzes, 1, 2, 3, 4. The ores from the galleries, D, are delivered at the whim shafts, E, E.

The ground plan exhibits the extent of the workings in December, 1854, and from it may be gleaned some idea of the amount of ore immediately available, as well also as the very judicious manner in which the mine is conducted, both for convenience and economy. The ores from the lode, like all the other mines of this section, are breasted out, giving ample and convenient room for the disposition of the attle. The strike of the lode is north eighteen degrees west, with a dip of 20°, and power of three and a half feet.

The complement of laborers at the mine is thirty-four, and including the reduction works, it amounts to about forty men actively engaged.

Jones's and Davis's Mine, Amador County.—The mine and reduction works are situated on the east side of a small tributary of the Amador Creek, the latter passing through the town of Amador one mile north of this mine. The top of the whim shaft C is one hundred and forty-five feet above the level of the creek, and ninety feet below the outcrop of the vein to the south. The shaft 4 on the vein is three hundred and sixty-four feet above the town of Amador. The design of the company in the working of their mine, as mentioned in the report of last year, has been carried out, the connection of the lower level throughout having been completed but a few days before I visited the mine this year. The mine, as now opened, presents the following arrangement: whim shaft C, 100 feet; south shaft, 140 feet; upper level, 280 feet; middle galleries, 150 feet; bottom levels, 180 feet. The amount of work completed within the past year is indicated by the dotted lines, and the total amount of excavation on the lode is exhibited in the dark shades of the accompanying diagram. The characteristics of the mine and the investing rocks, and reduction works, are seen by reference to the latter.

* The diagrams referred to in this report have not been printed by the Legislature.

This company have erected a thirty-horse water-wheel and double-battery of eighteen stamps, their power is sufficient to reduce 25 tons of ore per day. They have discontinued the use of steam.

The full complement of laborers for this mine during the ensuing year, will amount to twenty-three; they have formerly employed thirty-four doing the opening of the lode.

Keystone Mine.—Situated about three fourths of a mile south of the former, and on the same tributary of the Amador. It is evidently a parallel lode with that of Spring Hill, and Jones's and Davis's mines, and is situated about twenty-five feet above the level of the Creek. The adit runs nearly east and west for the distance of one hundred and ten feet, at which point the lode is cut with a power of three feet, at nine fathoms from the surface. At the end of the adit, a shaft has been sunk through the lode for seven fathoms; its diameter is four and a half feet. This shaft is heavily timbered, and well ceiled, the planking and frame snugly jointed. It is one of those operations that partakes strongly of the character of permanency in its design and construction, like most other of the workings of 1854 in this branch of business. The diagram presents the work on the lode as now progressing. The old gallery at the end of the adit has been driven to 100 feet on the south, and ninety feet on the north. The gallery 18 feet above the end of the adit, has been carried 100 feet in each direction. The level at the bottom of the seven-fathom shaft is 94 feet, with a power in the lode of five feet.

This company have also abandoned the use of steam for power, and have erected a forty-horse water-wheel, and heavy battery at the old reduction works. They have also built another large mill south of the former, of equal capacity, in order to work their mine at distant points to better advantage.

The complement of laborers at this mine for the present is sixteen, but on opening the southern workings they will employ about thirty-five. Many important and valuable improvements have been made during the past year on this mine.

Midian Mine, (*Lea & Johnson's*).—This mine is beginning to show its true character, a handsome lode and much decomposed at the bottom of the nine-fathom shaft. At the bottom of this shaft, two short levels of forty feet each have been driven, which shows a power of three feet in the lode at those places. On the south end of the vein an adit has been driven sixty-six feet, at the end of which the lode was struck with a power of four feet, on this one level has been driven of fifty-six feet. The vein shows a fair prospect.

The company have erected their reduction works this year, but were not in operation at the time I visited the mine.

Eureka Mine.—Situated near the town of Sutter, county of Amador. The whin shaft A, has been carried from seven to sixteen fathoms during the past year. The adit enters from the west, and is about one hundred feet in length. The upper gallery has been carried south of the adit a distance of one hundred and fourteen feet, and north seventy-five feet. The middle gallery is thirty feet below the preceding, and opens at the whin shaft, being driven on the north sixty feet, and south eighty-five feet. The level at the bottom of the sixteen fathom shaft, is one hundred and forty-four feet in length. The tramroad which was commenced last year has been completed for nine hundred feet, and is now within some eighty feet of the lode. The rocks are a graphic slate, very firm, and often charged with pyritic crystals.

The rich thread which commenced at the surface, and for fifty feet in depth, was highiy pyritiferous; is found at the bottom of the main shaft much more productive. The pyrites have ceased entirely at this depth, and the hilo is composed of metallic gold, not disseminated, but forming a true vein, at times exceeding three eighths of an inch in thickness. The vein has been struck in an adjoining mine, about one thousand feet to the south. This is the only instance of a true vein of metallic gold having been found in this State.

The complement of laborers in this vein is sixteen, and the capacity for reduction of ores about ten tons per day.

Statistics of Mines.—During the past year I have obtained statistics from fourteen of the gold mines of the State. These consist of mines located in the counties of Shasta, Nevada, El Dorado, and Amador. The statistics consist of all general and incidental expenses, the number of operatives employed as miners, engineers, tenders, &c., with their wages per month; expenses of fuel, teaming, dead work, quantity of ore reduced per day, average product of the same, with monthly and annual receipts. These statistics were taken from the books of the companies, and may, therefore, be entitled to confidence as a fair exhibit of the character of this branch of mining.

To save time, and at the same moment render the subject more comprehensive, the aggregates of these statistics will be given:

Capital invested,	$798,000
Net receipts,	1,488,000
Expenditures,	507,000

In addition to the above fourteen mines, there are thirty others which have continued in operation during 1854, and which, from the known investments of the preceding year, will give an additional investment of $384,000. From the net proceeds of the fourteen mines above known, and their expenses, it would be safe to assume that the thirty not heard from, have yielded fully fifty per cent. on their capital invested. This, it will be seen, is much below the proportion of the first. This then would give for the total number of mines, an amount of capital actively employed, as follows:

Investments,	$1,127,000
Gross receipts,	2,157,510
Total capital and products,	$3,284,510 for 1854.

From the above it appears that the aggregate product of these mines is about four per cent. of the product of the State, as far as the latter is known with any degree of certainty.

The aggregate number of persons actively employed in extracting the ores, and in reducing the same, amounts to six hundred and ten, bearing a very small proportion to the great mass engaged in the other branch of mining in the State.

In regard to the above figures, I would state that they represent rather the minimum than the maximum of investments and receipts, and it has been a leading object in collating these statistics, to avoid those extravagant estimates, heretofore indulged in, with relation to this subject.

The above list of additional mines, with the number still actively engaged from last year, swells the aggregate number for 1855, to fifty-three mines in actual operation, and a net increase of thirteen from the preceding year over all that have suspended for any considerable length of time.

Water Companies.—The table below will give an approximate idea of the value and extent of our artificial water courses, constructed for the purpose of facilitating mining operations. The valuation in the aggregate of the counties are placed at those figures on which they are known to yield a profit of five per cent. per month. The estimates are based on a careful examination of the aggregate receipts of eighty-three of one hundred and nine companies included, and our list comprises but seven of the principal mining counties of the State. Much interesting local details was obtained, which the want of time this year prevents from appearing in these pages:

TABLE.

Counties.	No. Companies.	No. Miles.	Valuation.
Amador,	15	129	$298,000
Calaveras,	12	165	397,000
El Dorado,	10	178	380,000
Nevada,	27	210	412,000
Placer,	11	160	369,000
Sierra,	14	187	180,000
Tuolumne,	20	185	446,000
Total,	109	1,159	$2,480,000

LIST OF NEW AND RESUMED MINES FOR 1854–5.

The following is a list of those mines that have gone into operation within the year 1854, comprising those which have erected works for the reduction of their ores.

Name of Mine.	Location and County.
Crœsus,	Auburn, Placer County.
Canada Hill,	Canada Hill, Nevada County.
Van Ammon,	Wolf Creek, "
Orleans,	Grass Valley, "
Whitesides & Co.	Wolf Creek, "
Rocky Bar,	Grass Valley, "
Mount George,	Mount George, "
Pacific,	Placerville, El Dorado County.
Maryland,	" "
Whitlock's,	Logtown, "
Bryant's,	" "
Fort John,	Drytown, Amador County.
Badger's,	Sutter, "
Tuolumne,	Sonora, Tuolumne County.
Orleans,	" "
Experimental,	Columbia, "
San Juan,	Mokelumne River, Calaveras County.
Burleigh,	" "

Mines omitted in report of last year, and still in operation.

Mount Pleasant,	Grizzly Flat, El Dorado County.
Sierra Nevada,	" "
Eagle,	" "
Pocahontas,	Logtown, "

IMPROVEMENTS IN CALIFORNIA.

A resident of California who has been traversing the Mining district furnishes us with the following sketch of its improvements.

The present mining district in California embraces a belt of land thirty miles wide, by about six hundred long. All this territory is traversed by numerous streams of water, each having many lateral branches, but these branches fail of water soon after the cessation of rain in the spring. The main rivers supplied by the melted snows never fail, but they cut their valleys so deep, that their waters, in the natural bed, are seldom available for mining purposes. In early days, the miners worked along the lateral streams in the winter and spring, and in the summer abandoned their claims to go to the river bed.

It of course soon occurred to them, that if by art these permanent streams could be diverted from the natural bed, at a proper elevation, and conducted along the hill sides, in ditches and artificial channels, the water could be used to great advantage. To accomplish this work a large number of joint-stock companies were formed. Labor was then so high that these experiments were soon found to be a bad speculation. All, or nearly all of them failed. Since then, however, many of them, under private management, have been eminently successful, and are doing more to render the yield of gold uniform and certain than any other mode of operation.

As to the quantity of earth and rock which has gold in sufficient quantities to be remunerative, it is useless to attempt an estimate. It will require ages at least to exhaust such an immense supply, and the annual yield will only depend on the number of miners and the supply of water necessary for working. Emigration to California is not as great just now as formerly. This is probably caused by the great demand for labor in cultivating the soil, and also by the bad news from there during the early part of the present year.

A great change has come over California since 1848 and '49. Then the

poor miner slept on the ground, with nothing but a blanket to cover him, and paid on an average, one dollar per pound for all his provisions. Now they have comfortable houses, hotels, and boarding places, with moderate prices. Stages and wagons communicate daily with the market-towns, and the telegraph announces the prices and the latest news. So marked a change is almost a miracle. But what is more astonishing perhaps than all, in this hitherto barren territory, is the many cultivated fields and gardens, abounding in every description of grain and vegetable. These changes are having a marked effect on the growth and prosperity of San Francisco. Formerly that city was the only place to obtain food or merchandise. Every article of necessity or luxury paid its tribute to this western metropolis. Now agriculture is encouraged and rewarded, and food in abundance may be had of their own raising in almost every locality. Machinery and tools, which were formerly imported from New York and Boston, through Yankee enterprise, are now manufactured at home.

San Francisco, therefore, for the present, has more houses and stores than can be profitably occupied. The growth of that city will consequently not be as rapid as formerly, but its progress will be steadily onward. The United States mint is now coining about $100,000 per day, so that but little gold goes to the private assayers for bullion. The bulk of the shipments now from there is in United States coin. Until within a year past, they were almost exclusively in "dust." This change will have a great influence on banking and exchange operations, and very much reduce the expense of remittances to the Atlantic states. Any thing like caution or prudence has heretofore been deemed unworthy of California, but now, when the days of moonshine speculations are over, and it is found that gold only can be obtained by hard labor, the people are beginning to believe that thrift and economy are as necessary there as in any other part of the world.

This new country thus far has been an enigma, but it will soon cease to be so, when every department of business will be safe and satisfactory. The developments of the past year, the downfall of Page, Bacon & Co., Adams & Co., and others, will discover to all the dangers into which they have recklessly plunged, and lead to intelligent and careful future action. All this experience and discipline has been ordered by Divine Providence for the present and future good and glory of a country, destined inevitably, we believe, to eclipse in wealth and grandeur any other spot on the habitable globe.

IS GOLD DEPRECIATING?

This is a question which has been considerably agitated of late by commercial writers, and too often without a satisfactory result. There are some points in the annexed article bearing upon this question, which, if they do not prove depreciation in gold, show at least that the commercial facilities of the world are not proportionally increased. It is translated from the *Aktionare*, a European journal:—

"Since some years there has been much interesting matter written in relation to the value of the noble metals. The majority of estimates in relation to the quantity existing at the time of the discovery of California, make the total nearly $1,200,000,000; some place it at over $2,000,000,000. We do not place the figures so high. But it is to be considered, also, about what is the total of those things which require the functions of money.

"We will attempt a general estimate, placing the quantity of coined gold and silver, including ingots:—

Which are not in bank, at	£ 500,000,000
Bank notes in circulation in the world	250,000,000
Inland exchange of all countries, estimated on the British stamp for 1854	600,000,000
Private debts and credits not represented by exchange	1,500,000,000
Government stocks and shares on the various stock markets	1,500,000,000
Total	£3,000,000,000

"This may be considered a very moderate estimate of all those things which in all countries require the services of the metals. If now the gold countries discovered since 1846 produce together £30,000,000 annually, the result is one per cent. of the above sum. Population, necessities, and prosperity, however, increase, irrespective of higher prices and wars, more than one per cent. The rest of the world, not speaking exclusively of wholesale trade, is served with metallic money as well as credit—of coined money there is always about the same quantity, but credit is very elastic. The periods of so-called money scarcity, that is, contraction of credit, and money abundance, that is, expansion of credit, are taken for each other reciprocally.

"What may be the annual exchanges of the world?

"The *Journal des Debats* for January 15, 1851, puts the annual interchanges of known countries at £1,200,000,000, half of that is exports and half imports. Now, every article before it is exported will, on an average, be exchanged twice; and every article imported will likewise be exchanged twice,

Making an exchange of	£2,400,000,000
The population of the money-using world may be taken at 600,000,000, and every individual buys of domestic produce $25 worth, not included in the above estimate, and after these purchases pass through two hands, the result is	6,000,000,000
The quantity of stocks, shares, &c., of all descriptions of companies in the world, which is annually bought and sold, is taken at . .	3,000,000,000
Annual sales, houses, lands, &c.	600,000,000
Total	£12,000,000,000

"Of what importance, in comparison with this sum, is an annual production of £30,000,000 of gold! It is about one fourth of one per cent.

"But the above estimates are far too small. If we take the productive value of all lands at only £6,000,000,000 per annum, and allow these to be twice exchanged, we have alone £12,000,000,000, exclusive of the operations in stocks, houses, lands, &c. The chances that more gold countries will be discovered are less than that the present production of California and Australia will not be sustained. If we do not regard the present production as likely to depreciate the metals, we are far from thinking the yield will be without influence. On the contrary, we expect from it a very important stimulus to enterprise and speculation. It is just possible that a production of 30,000,000 will be as great a stimulus as one of 60,000,000. The consequence will be the contrary of a depreciation of gold.

"Many believe that the present high prices of things are to be attributed to gold; but in the case of food, and all relatives to it, we have direct reasons, apart from gold influence, and of other articles we can see none of which the stocks are not disproportioned to the consumption, as compared with the seasons of lower prices.

"From 1847 to 1853, when the English crisis and European disorders had subsided, low rates of food, attended with unusual prosperity and great power of consumption, enhanced by the restored feeling of political security, the progress of free trade, the increase of means of communication, and the direct influence of the gold receipts, were all causes of higher prices.

"Those whose views are like our own, will not expect a reduction of the value of gold in respect to silver. If prior to 1847 there existed 1,200,000,000 of the metals, 33 per cent. gold and 66 per cent. silver, and gold has been produced at the rate of 30,000,000 annually, the proportion increase is only 1½ per cent. But the increase of business has been in those countries, England, France, and the United States, that have gold standards, far greater. France has used a silver standard, but designs adopting gold. Since 1795, she has coined £173,000,000, but the coinage has now ceased. It has been estimated that within a few years France possessed £80,000,000 of silver, of which the larger portion has been exchanged for gold, and thrown upon the markets of the world. Other countries also, Germany and Switzerland, absorb more or less gold. The use of silver for mechanical purposes has been less than it was. The production of silver through the abundance of mercury is enhanced.

"In conclusion, it is to remark, that if the population of this money-using world is 600,000,000, an annual production of £30,000,000 is about one shilling per head."

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

The force at work in the mines at Lake Superior, is about the same as during the winter months, and much smaller than in last year.

SHIPMENTS OF COPPER.

The shipments of Copper from Ontonagon for the year up to about August 1st are thus reported in the *Lake Superior Miner*.

Minnesota and Rockland,	1,661,302 lbs.
National,	56,369 "
Forest,	212,763 "
Norwich,	315,461 "
Ridge,	80,540 "
Nebraska,	37,600 "
Ohio Trap Rock,	42,733 "
Adventure,	91,470 "
Douglass Houghton,	52,145 "
Bohemian,	4,592 "
Toltec,	117,516 "
Windsor,	67,679 "
Evergreen Bluff,	14,690 "

EVERGREEN BLUFF MINE.

The latest details we have of several of the mines are furnished by an intelligent correspondent of the *Pontiac Jacksonian*.

This mine is situated one and one half mile from the plank road, and for convenience of location, is not surpassed by any of the new mines. Got dinner and then visited the mine. This company have drifted into their bluff, an adit of 260 feet upon the vein, and, all along, find copper in small masses, and rich barrel and stamp work. This bluff has an elevation of nearly 300 feet—in many places almost perpendicular, and all across it the vein crops out with fine evidences of richness, and filled with ancient pits. The stone hammers used by the ancients, are found here in abundance. This company is, at present, working twelve miners and six surface men, and the mine is thought by all who visited it and made an examination, to present as fine indications as any new mine on the range. They have already sold nine tons of copper, and have now one and one half tons more ready for shipment. Of their sales the following is mass copper: No. 1, 1,245 lbs,; No. 2, 260 lbs.; No. 3, 240 lbs.; No. 4, 775 lbs.; No. 5, 1,175 lbs.; No. 6, 205 lbs.; No. 7, 170 lbs. This copper has been taken only from the adit in opening the mine, and no stoping has been done to obtain it. The company have expended about $13,000, and have on hand about $10,000 from assessments already made for the future working of the mine. Economy is apparent in all the working of this mine, and every appearance indicates that it will soon be one of the paying mines.

Ridge Mine.—From the Evergreen we went to the Ridge Mine. This mine is situated about half a mile from the Evergreen. It is working from 60 to 80 men all told, and is now erecting a lifting engine, which is just ready for operation. This mine produces mostly barrel and stamp work, and has

sixteen head of stamps. This company have expended $75,000 or more—are producing from four to six tons of copper per month, and must produce at least ten tons to make it pay expenses, which they expect to do when they get their lifting engine in operation. Here we were conducted through the mine by the mining captain—two shafts 300 feet apart, sunk 360 feet deep—went into one and out the other, and passed through all the mine, being 360 feet under ground, while blasts exploding around us, with their resounding thunder, gave us an idea of the noise of the storming of Sebastopol.

Adventure Mine.—This mine we next visited. It is situated about one mile from the Ridge mine. This company have expended a great deal of money opening ground, but with the pressure, were forced to cease working in the ordinary way, and the agent then worked this mine upon *tribute*. This is a system of mining by which miners take out copper upon halves, or in other words, the company pay them $120 per ton, half the estimated value of the copper. They are getting now about 20 tons per month, but how long this can continue is quite uncertain. There are about 60 miners at work here. This system of mining is not generally approved by mining men. It is thought the miners, under this system, will soon get out all the copper exposed, and the company will then have to incur the expense of opening new ground.

Merchants' Mine.—This company is working but few men, and with but little show at present. The mine is about halft a mile from the Adventure.

Toltec Mine.—This mine is about a mile from the Adventure. We reached here just about sunset. This mine is under charge of Mr. Sales, who is said to be one of the best mining men in this country. Here we found the best surface improvement of any mine upon the range, and one would imagine himself in some newly built and thriving western village. We went into the mine same evening, conducted by the mining captain. This is one of the finest worked mines on the Lake. The vein is rich in stamp work, and is now beginning to develope mass copper quite extensively, and gives good indications of soon being a paying mine. We saw, in the lowest level, a mass just uncovered, measuring 20 to 25 feet in length, in the drift undeveloped, but which indicates a large mass. This company have opened a great deal of ground, having three levels of 1,100 feet in length—have expended $200,000 assessments, besides sales of copper—are getting out 10 to 15 tons of copper per month, and must get at least 10 tons per month to pay expenses, which they have good assurance of doing soon. They have 32 head of stamps, the largest works of any mine—saw-mill attached, and machinery driven by two engines of forty-horse power each. This company is so situated that they have a great many visitors all the while, as it is but a pleasant drive to go up the plank road and visit this mine and return, if time will not permit any further excursion, and a pleasanter set of gentlemen than you meet here cannot be found any where. We staid at this mine over night.

Nebraska Mine.—This mine is situated about one mile from the Evergreen, and at the southwest end of the same bluff. Here we found a drift upon an adit level of about 200 feet, at the mouth of which most of the copper has been obtained. They have taken out some 13 tons of copper, and they have taken all that was in sight, and in so doing they have sunk at the mouth 20 to 30 feet. The vein now at the end of their drift has almost entirely disappeared, and they are sinking a shaft in the conglomerate rock with the hope of finding copper. They are working some 20 or 30 men.

Rockland Mine.—We next reached the Rockland Mine, the favorite mine of all the diggings. This mine is worked by Captain Jennings, who was, for a long time, at the Cliff Mine. This mine is north-east, and adjoining the Minnesota Mine, and on the same range, and may be said to be the same thing, only a new mine. This mine has an adit level to reach the vein, 270 feet, and a drift upon the vein 700 feet. This is mass copper with some stamp work. This company have not as yet erected any stamps. Here was the largest mass found that has ever been discovered so near the surface. It was found on opening one of the ancient pits, and within ten feet of the surface.

At the head of the mass the ancients had endeavored to get off a piece of copper, and the end was rounded with a ring, or neck piece, formed by the hammering, but which was not separated from the mass. This measures enough for 100 tons. Already some 20 tons have been taken from it, and the mass gives more thickness and breadth as it is exposed. The mass cut from the top, containing the neck, was sold upon the ground, to go to Liverpool for exhibition for 22 cents per pound—weight 6,075 lbs. It was on the wagon to go to the landing. In speaking of the mines here by comparison, the Rockland and Minnesota are always excepted. This mine is getting out about 20 tons of copper per month.

Minnesota Mine.—This is the great mine of the Ontonagon country. It works 400 men, 200 miners. For the last three months they have taken out 114 tons of copper per month, and will take out 1,200 tons in the year. We passed through this mine, conducted by Captain Harris, and no other mine gives a person any idea of the richness of the copper mines of Lake Superior. Their expenses are $14,000 per month, and yearly dividends upon stock $135,000. No wonder that a mining fever should range here from such results. They have 200 acres of farming land, covered with oats, potatoes and grass—shafts 400 feet deep, and five levels 2,300 feet long.

National Mine.—This mine we reached in a little less than a mile from the Minnesota. This company are at present working from 20 to 25 miners. Their location is on the school section, and is the location out of which John Bacon made so much money. They are not doing much at present, and although the stock has been as high as $30 per share, it is now quoted at $12 to $15. This company and the Minnesota company are litigating about 160 acres of land, lying between their works, the value of which is not less than $200,000. The Minnesota succeeded in the United States District Court at Detroit. The case has been appealed to the Supreme Court, and I have no doubt the National are awaiting the result before working a great force. It must be all important to the National to succeed in the suit, and should the decision of the District Court be sustained, the stock of the National will undoubtedly be much more depressed. From the National we trudged on three or four miles, dragging our weary limbs along until we reached the river Ontonagon, at the Forest landing—met here, R. Livingston, the agent of the Forest mine, who escorted us up to the mine, and here we enjoyed a night of "sweet repose."

Forest Mine.—This company have expensive stamp works, saw-mill and machinery at the river at their landing, one mile from their mine. This mine is elevated some 600 or 700 feet from the river, and from which we had a most magnificent view of the surrounding country, and as the lofty bluff and mountain ranges break upon the view, with the Lake at a distance, apparently above them all, the scene is indeed enchanting.

The company have 24 heads of stamps, with their machinery and saw-mill driven by two engines of 40 horse power each. They have a team railroad from their landing to the mine, a distance of 1¼ miles, for the transportation of their stamp rock to their stamp works, which is all the way on an inclined plane, so that the weight of the cars furnishes sufficient power for speedy locomotion downwards, while the cares are drawn back by horses. At a distance of 60 or 80 rods from the river is what they call the *inclined* plane. It is upon a bluff, and makes an elevation of 225 feet, at an angle of twenty-two degrees forty-five minutes. The cars are worked up and down this plane by the force of gravitation, a loaded car being made to draw up an empty one, or one partially loaded, if any load is to pass up to the mine. We thought a railroad trip might be a relief to the dull monotony of our wearied tramp, and we got into a car with Mr. Livingston, and away we went up the plane at the rate of 30 miles an hour. You would have smiled to have seen us holding on to the cars as with a dead grip, and our friend B., thinking it best to be prepared for accidents, with his feet over the car ready to jump, if need required. The jumping would all have been well enough, but there might have been some difficulty in alighting. Their road, with rolling stock, cost $10,000.

This company have expended a great deal of money, have fine surface improvements, and a great deal of ground opened, but so far have produced but little mass copper—their work is mostly stamp work; some barrel work, and although their stamp work is rich, which is claimed by some to pay better than any work, yet experience teaches, that mass copper has paid, so far, much the best in our mines. This company have expended $240,000 of assessments, besides their produce, and their stocks are quoted at $4¼ to $5. They are working 50 miners and 150 men, and richly deserve a return for their investment; but if they do not get it, it must be placed to loss account of the aggregated cost of developing a mining country. Mr. Livingston is a gentleman of fine abilities and business capacities, and is a practical engineer, which knowledge is frequently brought into requisition in and about a mine. No one could be better cared for than we were, while enjoying his hospitality. Having been furnished with horses, by the kindness of Mr. Livingston, we started for the Norwich and Windsor mines, under the guidance of Mr. Sanderson, formerly the clerk of the Forest mine, and here was a chance for a display of horsemanship—our friend N. said, for seven years he had not straddled such an animal, and he spoke truly, for as he went on bounding between Heaven and Earth, he seemed to possess the elasticity of an Indian rubber ball, as he flew away from the saddle. Ten miles of travel, 30 seemingly, on the trail, over "hilly leap and hollow steep," tree tops, rocks and rubbish, brought us to the Norwich mine.

Norwich Mine.—This mine is under the charge of A. C. Davis, agent, who deserves much credit for the manner in which he worked the mine, and struggled on when the credit of nearly all the mines was crushed. They are now working 60 miners, and 125 men all told. They have already shipped 145 tons of copper, and are taking it out in abundance, and have now about 20 tons of mass copper at the mouth of the adit. They reach the river at the American landing. They have 16 heads of stamps, and have sunk shafts 350 feet, and have spent $140,000 assessments, besides produce of mine. This is in reality a mass mine, and stands next to the Rockland, and if assessments are paid promptly, they will soon be out of all embarrassment, and be a paying mine.

Windsor Mine.—East, and adjoining the Norwich, is the Windsor, working 50 or 60 men, have shipped 38 tons of copper, have two shafts, one 215 feet, one 287 feet, and adit level 600 feet. This is a fine mine, and should stockholders take a look at it, they would willingly pay the assesments, to prove it fully, with assurance of quick return.

PORTAGE LAKE DISTRICT.

The acounts from the mines in the region of Portage Lake are becoming quite favorable. The Lake Superior Journal represents them as highly flattering!

Isle Royale Mine. From Isle Royale Mine we learn that every thing is now in readiness to go on with the work of getting out and securing copper for market. The dfficulties which have stood in the way have been overcome, and the Agent is now prepared to push on the work with the greatest dispatch. The working has not, however, been suspended, the amount of copper got out in the month of July being 80 tons. A like amount has been estimamated for the month of August. The amount ready for shipment at Portage Entry is 50 tons copper. The total estimated product of the mine for the current year is 250 tons. Thirty-two heads of stamps have been sent up, and will be in operation by the first of September.

This has been considered the best mine on Portage Lake, and bids fair long to sustain its reputation.

A new company, whose mine is called the Quincy and Pewabic, are very sanguine as to the richness and extent of Copper Deposit on this location.

This mine has been worked during the past winter by six men on shares. The amount cleared by them during the winter is $4,000,—we are told that the vein, where opened, has yielded at the rate of five tons per fathom, and that there are no signs of the veins diminishing in size or richness. On the contrary, wherever the vein has been struck, during the proving up process, the same richness has been observed. This seems almost incredible, as the richest yield of the Cliff, or Minnesota, has never exceeded, to our knowledge, the half of this amount per fathom. We are assured, however, that such is the case, and one person says that with the help of one or two practical miners, he could soon get out enough to make him independently rich. A vast deal more labor will be necessary before this or any other new mine can be profitably worked. The idea of sudden riches has given place to a steady, practical feeling, that money must be laid out and men employed for some time before any return in the shape of Dividends can be expected.

The Portage mine is being worked steadily and persistently. The amount of copper that will be got out during the present year has been estimated at 60 tons. This is the lowest mark, many even computing the return at 75 tons. The stamp works are nearly completed, and in about two weeks' time the whole will be ready for operation. Thirty-two heads of stamps have been set up.

This is indeed cheering news from Portage Lake; should the account we have given be verified by shipments of Copper commensurate with it, we may congratulate these companies upon their bright prospects.

Toltec Mine.—The last report of Mr. Sales, the superintendent of this mine, has not been as yet noticed in these pages. For reference, as to the progress of the mine, we make the following extracts:—

On the 1st of May, 1854, the whole amount of mining accomplished to that date, from the commencement, was as follows:—

864 feet of Shafts sunk.
145 " " Winzes "
1,506 " " Drifting.
196 " " Cross-cutting.
160 14-36 fathoms of Stoping.

Of which, the following amount was done on the feeder:—

374 feet of Shafts sunk.
454 " " Drifting.
17 fathoms of Stoping.

From the 1st of May, 1854, to the 1st of March, 1855, the amount of mining done was as follows:—

351 8-12 feet of Shafts sunk.
199 4-12 " " Winzes "
784 2-12 " " Drifting.
364 23-36 fathoms of Stoping.

Which amount, added to the amount done prior to May 1st, 1854, gives:—

1,215 8-12 feet of Shafts sunk.
344 4-12 " " Winzes "
2,290 2-12 " " Drifting.
196 " " Cross-cutting.
525 1-36 fathoms of Stoping.

There are four shafts, sunk to various depths in the vein. No 1 (recently commenced), is 56 feet; No. 2 is 206 feet; No. 3 is 226 feet; No. 4 is 202 feet; besides which, a shaft has been commenced near the mouth of the proposed adit, and nearly 1,000 feet west from No. 1, and sunk to the depth of 35 feet; this shaft was merely designed to show the vein, and not commenced for the purpose of sinking it to any considerable depth, at present. It can be resumed when the gradual working of the mine, in that direction, shall render it necessary; the vein at this point is very rich, and fully two feet wide.

The size of the working shafts of a mine, being a matter essential to economy, I have deemed it necessary to have them large—sufficiently so for all practical purposes, present and future; their size is eight feet by ten feet clear. At all of the shafts, excepting one, there is a considerable depth of soil, which involves the necessity of lining them with heavy square timber, from the surface to the depth attained by the soil; for instance, at No. 1 shaft, the soil is 60 feet; No. 2 shaft, 30 feet; and No. 3 shaft, 20 feet. These shafts have been timbered up with great care, and are of the most permanent character.

Level No. 1 is from 80 to 1000 feet below the surface, and is driven 1010 feet in the vein. Level No. 2 is 60 feet below No. 1, and has been driven 1100 feet. Level No. 3 is 60 feet below No. 2, and has been driven 45 feet. There have likewise been three winzes sunk between shafts from No. 1 level to No. 2 level; and three from No. 2 level to No. 3 level. My object in sinking these winzes, was for the purpose of ventilation, before the shafts were connected by the levels, for proving the ground, and also to facilitate stoping down the vein.

The characteristics of the vein at the Toltec Consolidated Mine, are regularity of dip and direction. It is composed principally of quartz and spar, with epidote, laumonite, chlorite, and phrenite, in various proportions. It is rarely less than one foot in thickness, and frequently from three to four feet. It produces large quantities of excellent stamp copper, with a very fair proportion of barrel and mass copper. The latter description has increased in size and frequency, from the commencement. In the year 1852, at the depth of 60 feet, a mass of 700 lbs. weight was taken out. In 1853, at the depth of 70 feet, one of 1,600 lbs. weight was found. In 1854, at the depth of 90 feet, one of 4,200 lbs. was taken out; and in the month of February, 1855, at the depth of 130 feet, we discovered a mass, which has since been taken out of the mine, and weighed 23,300 lbs. The mine, during the periods stated above, has produced several masses of less weight, varying in size from 300 lbs. to 1,500 lbs., the largest of which has been produced within the last twelve months. This is undoubtedly a very gratifying feature in the mine; and when the limited quantity of ground stoped is considered, and the point at which most of this stoping has been done (above the first level, from 30 to 80 feet from the surface, at which depth veins are not generally expected to prove very rich), we are justified in anticipating the most favorable results from the vigorous prosecution of operations, which will undoubtedly be amply justified by the increased yield of the mine.

I have stated above, that there have been 525 fathoms of ground stoped in the mine. The product of this ground in copper is as follows:—

Shipped in 1853 and 1854	15½	tons.
Ready for shipment at the Lake	25	"
3,000 tons of stamp-work, estimated to yield 3 per cent. of copper	90	"
Making in all	130½	tons.

Which gives 497 lbs. of copper as the yield per fathom.

There are now thirty-one hundred fathoms of ground ready for stoping, which will probably yield as much to the fathom as that already stoped, and perhaps much more, as the vein is very promising at all points, and at many places small masses are in sight. The shafts and winzes already sunk, if connected, on the third level, by a drift, would give eighteen hundred fathoms more of stoping ground. The vein at the bottom of the shafts (third level), is of the most encouraging character, which cannot fail to realize the most sanguine expectations. I am so well convinced of the increasing richness of the mine, going down, that I deem it of the greatest importance to its future production, that the shafts should be connected on the third level, with as little delay as possible, thereby giving us nearly five thousand fathoms of stoping ground, to stope out which will require the constant labor of one hundred

miners for eighteen months; the product of whose labor will not more than keep our stamps employed, after stamping out the stuff now on hand.

The amount of copper shipped from the mine in 1853 was 10,880 lbs.; in 1854, 20,000 lbs.: now ready at the Lake, for shipment, 50,000 lbs. in masses and barrel work, worth 20 cents per pound; we have at the mine 3,000 tons of stamp work, estimated to yield three per cent., giving 180,000 lbs. Worth, after deducting cost of stamping and washing, $30,000.

The following are the statistics of operations in the mine, and expenditures, from May 1st, 1854, to March 1st, 1855:—

351 3-12 feet of Shafts sunk at cost of	$3,847 50
199 4-12 " " Winzes " "	2,027 33
784 2-12 " " Drifting " "	6,042 27
364 23-36 fathoms Stoped, " "	6,971 98
Total Mining Expenses, 10 months	$18,889 08

The above statement shows the extent of ground opened by drifting and sinking 1,334 9-12 feet, and 364 23-36 fathoms stoped.

The average prices paid (inclusive of mining costs), are:—

For Sinking, per foot	$10 67
" Drifting	7 70
" Stoping, per fathom	19 12

The average number of miners employed during the time above stated (10 months), was 45; present number 43.

STANDARD OF COPPER ORE.

Since my arrival in this city, I have been requested to furnish a plain definition of the term "standard," as applied to copper ore; for I am told there still exists among persons not conversant with practical mining much mystery respecting its real meaning.

The word "standard," divested of its disguise, as applied to mining, simply means, "the present value of a ton of fine copper," and to be understood as to its practical effect, it must be associated with its two near kinsmen, "price" and "produce." Standing separately, they may be thus defined, viz., "standard," the value of a ton of copper; "produce," the number of tons of copper in 100 tons of ore; "price," the value of a ton of copper ore. Now, it will be seen that any two of these terms being given, the third may be found by proportion.

EXAMPLE.

Given standard, £116, and produce 8⅞, the "price" is required.

	£	s.	d.	
As 116 : 8⅞ : : 100=	10	8	0	
Deduct returning charge,	2	15	0	
Answer,	7	8	0	per ton.

Given "price," 10 8 0 Produce 8⅞, require the "standard."

As 10 8 0 : 100 : : 8⅞=Ans. 116.

Given "standard," 116, "price," £ 10 s. 8 d. 0 require the "produce."

As £ 10 s. 8 d. 0 : 100 : : 116→Ans. 8⅞.

These operations mutually prove the rule, and I suppose will render the meaning and effect of the "standard" clear to all parties.—Budge.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

LEAD MINES IN ST. FRANCOIS CO., MISSOURI.

This tract of land is situated in St. Francois Co., Missouri, about sixty miles south of the city of St. Louis, and twenty-five west of the nearest point on the Mississippi River, embracing the concession to Camille Delassus, or his legal representatives, confirmed by the government of the United States, and some adjacent territory; its entire area is about seventeen hundred acres. It has long been known to have upon it several valuable discoveries of lead ore; but, as no name has been heretofore applied that embraces them as a whole, it is proposed to call them after the county in which they are situated.

The State road from Farmington, the county seat of St. Francois County, to Potosi, the county seat of Washington County, passes through the southern portion of the tract. At Farmington, which is about nine miles east, this State road connects with an excellent plank road leading to Ste. Genevieve, on the Mississippi River; and on the west, at the distance of about seven miles, intersects the line of the St. Louis and Iron Mountain Railroad, at a point about seventy miles from St. Louis. The connections, therefore, of this State road, at these two points, afford a choice of routes for the transportation of the products of the mines to market, and will insure their delivery at all seasons at a moderate charge.

In its *geological character*, the formation embraced in this tract belongs to the lowest stratified rocks of the State, constituting a portion of what is known in this country and in Europe as the *Silurian system.* Three or four miles south of it, granitic and porphyritic hills and ridges occur, rising in some instances six or eight hundred feet above the level of the adjacent valleys; but as none of these igneous rocks present themselves at the surface, or have been reached in any of the mining operations heretofore done on this tract, or any of the country immediately adjacent to it, there is no means of determining with certainty to what depth it would be necessary to penetrate before reaching them. I have had occasion to investigate this question—one of great importance in its relation to future mining operations in this State—frequently, and all the evidences concur in rendering it highly probable, if not certain, that these lowest, lead-bearing stratified rocks, are at least as thick as it will be possible to penetrate them by human agency for practicable mining purposes.

A vertical line from the summit or highest point on this tract carried to the level of the valley of Flat River or Big River, would be about two hundred and fifty or three hundred feet in length. The nature of the formation to this extent is evident, for the rocks constituting it present themselves at various places so distinctly as to enable us to make out and identify every stratum. For about the first one hundred feet in the descending order, these strata consist chiefly of thin-bedded argillo-magnesian limestones, generally of a light fawn or buff color, interstratified with a greenish, slaty limestone. The striatgraphical position of this deposit is just below the lowest sandstones, and accompanying chert bed, which I have had occasion so frequently to refer to in other geological reports of certain portions of this State, as defining the upper limits of our great lead-bearing system of rocks. It is proper, however, here to observe, to prevent mistakes, and to enable geologists of limited experience in our formations to determine their position, that there is a marked difference here in the development of these two portions—the argillo-magnesian limestones and sandstones—from what occurs in other parts of Missouri. In a very large portion of the mineral region of this State, this sandstone, with its accompanying chert or quartzose bed, attains one hundred or more feet in thickness; but here, in the vicinity of Flat River, it has

thinned out so much as to be often difficult to find, and probably nowhere exceeds fifteen or twenty feet. On the other hand, the thin-bedded argillo-magnesian limestone, which elsewhere is so thin as to be unworthy of special notice, is found here to be developed to fully one hundred feet in thickness.

In a practical point of view, a knowledge of this change is also of importance. In other parts of the State, where the argillo-magnesian and shaly limestone, lying *below*—for it must not be forgotten that these kinds of rocks are almost every where largely developed *above*—the sandstone, is very thin or scarcely appreciable, the lead deposits begin as soon as we have passed through the latter rock. But this is not the case where the former are largely developed, as in the vicinity of Flat River. So far as my observation has gone, and so far as the experience of mining operations can be relied upon, no important deposits of lead ore, it may be safely said, occur in these lowest, thinly stratified or shaly limestone. Properly speaking, therefore, on this tract of land, and in this vicinity, it is these limestones, and not the overlying sandstones, that define the limit upward of our great lead-bearing series.

The true lead-bearing, magnesian limestone of Missouri lies immediately below these last-described limestones, occupying the same position here that it does every where else, and being the lowest, so far as it is yet known, of all the stratified rocks in the State. It is compact, thick-bedded, often very hard, sometimes semi-crystalline, and generally gray or of a grayish yellow color. Except in the small area in the south-western corner, where it is covered by the thin-bedded, argillo-magnesian limestones just described, it is the only rock visible on the tract, and certainly exists throughout its whole extent. The waters of Flat and Big Rivers have cut into or excavated it to the depth of from one hundred and fifty to two hundred feet, throughout all of which it continues metalliferous; and elsewhere in the State it has been penetrated to twice or three times this depth, naturally or artificially, and found to retain the same character. The experience of other mining countries—to say nothing of the theories which have been founded upon this experience of the connection of mineral veins with adjacent igneous rocks—justifies us in presuming that this metalliferous character will continue, as before remarked, at least as far as it can be followed by human agency.

This tract covers a portion of a belt of country extending east and west some fifteen or twenty miles, in which there are numerous other mines, as McKee's, Mine a Joe, Yankee, and New Diggings, all of which have been highly productive. The facility with which mining could be profitably conducted with the most limited means, early attracted miners; and hence we have in this region some of the oldest mines in the State. The discovery and opening of the mines of the Upper Mississippi, and the reduction in the price of lead which occurred about this time, from the inundation of every market by the Spanish mines, produced an effect upon mining operations in Missouri, from which it has never yet recovered. Before these events, many hundred miners were constantly employed upon this tract and the adjacent mines, and several furnaces kept busy in smelting the product; now there is not a furnace in the vicinity, the miners are numbered by units instead of hundreds, and the rent from the produce will not pay the taxes upon the land in many instances.

Although there is no doubt that every portion of this tract will prove to be metalliferous, at present most of the mining is confined to that part lying south of the Doggett claim; west of that claim there are a few "diggings," but as most of this portion of the tract is occupied for farming purposes, it has never been subjected to satisfactory exploration. On the east side of Flat River very little mining has yet been done on the property; but immediately adjacent to it there are mines that have proven to be very productive; and there can be no doubt, as there is no difference in the physical or geological character of the two, that they will be found of the same character in their mineral productions.

On that portion of the tract which has been chiefly worked, and upon

which your superintendent is now operating, there have already been found and proven numerous lodes; and there are indications of many others that have not yet been explored. In some places these lodes are only five, ten, or twenty feet apart, and many of them have already been proven for two, three, or five hundred yards in length. The general direction of these lodes is nearly east and west; but, in a few instances, they approach more nearly north and south. In almost all cases they are vertical, or nearly so, and otherwise fulfil the idea of a regular lode. In one case, where considerable work has been done, and perhaps in others, whilst this linear direction is still maintained, the lode expands and contracts alternately, giving somewhat the appearance of a *cave* lode. But, so far as I could observe or learn, it did not assume that labyrinthoidal form so characteristic of the true cave lode; and, therefore, cases like this can only be considered as modifications of the regular lode.

This regularity in the form of the lodes will greatly facilitate future mining operations. A single shaft in new ground will be sufficient to determine the direction of a lode; and others may be sunk upon it, as required, with certainty. Fortunately, the direction of many of the lodes is already indicated by the old shafts sunk upon them: these were generally from five to twenty feet, rarely thirty or forty deep, and, consequently, could have extracted but a small portion of each lode. For many years, there having been but little mining done on this tract, in these old operations we see the evidences of the limited means and practical knowledge possessed by the class of persons engaged in them. Without a knowledge of the condition of the country at that time, and the character of its inhabitants, we should look at such work as we have the evidences of here, and in this vicinity, now with astonishment. But they no doubt obtained what was then thought an adequate compensation for their labor, and that labor will now save a great deal of what might otherwise be profitless exploration.

The lodes on this tract are well defined, often consisting of nothing but clay and ore, and even when accompanied with calc spar (crystalline carbonate of lime) not difficult to work or follow. The general surface of the tract is so elevated that interference from water in any serious quantity need not be apprehended until the lodes shall have been worked to some hundred feet in depth. In former years, when a hand-windlass and tub was the utmost of the machinery to which a miner could aspire, and many of them had not even these, it is not astonishing that thirty or forty feet should have been considered a very deep shaft. In clay "diggings," which most of these were, where there is but a slow discharge of water by percolation, a summer shower was often sufficient to put a shaft in a condition to prevent it from being worked several days. Very few miners, at that time, knew any thing about the use of gunpowder in mining; and hence, when they reached a position that required blasting, the lode was abandoned at that spot, and another place sought adapted to their means for operation. In my operations in this region, I have re-opened many of these old shafts, and found valuable deposits of ore in the rock, just below where they were abandoned. There is no doubt this will be the case here.

Although, as before remarked, the whole of this property may be considered to be a mining tract, the principal part of the work heretofore done has been on certain circumscribed localities. The cause of that was, whenever a miner, in "prospecting," discovered a new lode, as he was only allowed, by the customary mining regulations, a limited area around his point of discovery, other miners, knowing from experience that the lode would extend beyond these limits, gathered immediately around him to avail themselves of it. Conseqently, not only that lode was worked over a considerable extent, but others were found in its immediate vicinity. What may be the extent or amount of the mineral deposits in the spaces intermediate between these localities, is yet to be determined; but there is no good reason why they may

not be as great as any of the localities already explored. In passing over these spaces, I saw many indications of a highly favorable character; and if mining were to be commenced now, *de novo*, on this tract, I would expect successful results on several of them, as certainly as where work has already been done. The miners of the vicinity have given to each of these mining localities distinct names: as, Cotton-wood diggings, Cave diggings, Tank diggings, Gaylor's diggings, &c. Inexperienced persons examining this tract, at the present time, might be imposed upon by these names and local operations, and infer therefrom that the lead deposits occupied only limited areas upon it. A few years of regular, intelligent work will prove the falsity of such an opinion.

It has been found already, by actual exploration, that the lodes are often, on this tract, in close proximity to each other when parallel, or cutting each other at acute and obtuse angles. Several parallel lodes are found at intervals of ten or twenty feet apart, forming, as it were, a band or system; and these not unfrequently cut through by one or more oblique lodes. It is evident that wherever this condition of things exists, it gives increased facility for economical mining operations. In such cases, a single engine and pump shaft may be made to serve several lodes, and some worked to advantage that would be too small to justify an independent exploration. It is quite possible too, and even probable, that these contiguous parallel lodes may be connected below; in which case, of course, they may be expected to be more valuable.

The character of the ore produced by the St. Francois mines is unexceptionable in every respect. It is remarkable for its purity; yielding as much lead as any other ore in the State. It works freely and easily, producing a metal fully equal to the best *Galena* lead. It can be used for all the purposes in the arts to which the latter is applied, and will command the same price in any market.

Viewing the St. Francois mines in every aspect, I do not hesitate to express the opinion, that, if properly worked, they will soon acquire a high reputation for thir production and profitableness. They have all the natural elements necessary to give them this character. The lodes are numerous, extensive, easily worked, and capable of giving employment to a large force of miners. The ore is of the finest and purest quality, producing lead equal to that from any other mine in the United States. There is a good furnacē site on the tract, with water-power—the most economical—sufficient for blast and other purposes of such an establishment. The land has upon it an ample supply of timber, for mining and smelting operations. The country is high, healthy, and picturesque; the climate mild, offering no impediment to mining operations, winter or summer. A good plank and State road now facilitate access to the Mississippi River; and in twelve or eighteen months a railroad will be completed to St. Louis, over which the products of the mine can be taken to that city.—*Prof. H. King.*

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

	Tons.	Cwt.
Shipments by Reading Railroad, to August 30th . .	1,587,433	19
" Schuylkill Canal, ...	683,833	11
Total	2,271,267	10
Same time last year	2,008,485	13
Increase	262,781	17

LEHIGH COAL TRADE TO AUGUST 27TH.

Summit Mines, ...	202,718	09
East Lehigh, ...	28,584	00
Room Run Mines, ...	49,711	19
Beaver Meadow, ...	26,598	02
Spring Mountain Coal, ...	102,980	08
Colerain Coal, ...	57,709	00
Stafford Coal, ...	6,886	08
East Sugar Loaf Company, ...	80,495	10
New York and Lehigh Company, ...	21,832	08
French American Coal Company, ...	8,940	16
A. Lathrop's Pea Coal, ...	1,926	13
Hazelton Coal Company, ...	98,844	00
Crauberry Coal Company, ...	47,654	06
Diamond Coal Company, ...	16,560	02
Buck Mountain Coal, ...	46,844	06
Wilkesbarre Coal Company, ...	28,644	01
Total, ...	771,489	19
Last year, ...	704,087	08
Increase in 1855, so far, ...	67,852	16

Coal transported from Tamaqua, over the Little Schuylkill Railroad, to Sept. 6th, 1855.

	Collieries.	Tons.	Cwt.
J. & R. Carter.	E. East,	6,489	04
J. & R. Carter, ...	Greenwood,	28,480	02
J. & R. Carter, ...	No. 4. "	26,545	07
do. do., ...	Lehigh,	19,141	18
Ratcliff & Co., ...	C. West,	11,617	02
Ratcliff & Co., ...	Newkirk,	29,189	19
Jones & Co., ...	do.,	20,596	17
Jones & Co., ...	Buckville,	83,934	17
Wm. Donaldson, ...	P. do.,	83,653	15
George Wiggan & Son, . . .	do.,	211,059	00
Peter Bowman, ...	do.,	286,009	09
Heaton & Carter, ...	D. Slope,	808,006	07
William Devan, ...	Slope,	174,098	15
Total, ...		297,722	18

CUMBERLAND COAL TRADE FROM JANUARY 1ST. TO AUGUST 25TH.

By the Cumberland Coal & Iron Co.'s Railroad.

	Tons.	Cwt.
C'd C. & I. Co..	107,585	15
Howard & Co..	789	18
Everett & Co..	4,522	01
Percy & Co..	2,161	18
	115,059	07

By the Cumberland & Pennsylvania Railroad.

	Tons.
Frostburg C. Co	28,655
Borden Mining Co	41,062
Allegany Mining Co	32,316
Carbon Hill C. Co	2,514
Union C. & I. Co	909
	105,456

Total from the Frostburg region for the season, 220,515.07 tons.

By the George's Creek Coal & Iron Company's Railroad from George's Creek Valley.

	Tons.	Cwt.
George's Creek C. & I. Co	22,941	08
Swanton Coal & I. Co	47,967	12
American Coal Co	65,733	03
Franklin Coal Co	5,157	00
	141,799	03

By the Hampshire Coal & Iron Company's R.R. from the Hampshire mines, via Piedmont.

	Tons.	Cwt.
Hampshire C. & I. Co	37,409	01

By the Baltimore & Ohio Railroad from the Bloomington and New Creek Collieries.

	Tons.	Cwt.
New Creek Co	2,885	16
Bloomington Co	171	00
	3,056	16
Total from the George's Creek region for the year	182,265	00 t'ns.
Total from the whole coal region for the year	402,780	07 "

COAL BREAKER AND COLLIERY ESTABLISHMENT.

A very full and interesting sketch of the Colliery of Messrs. D. P. Brown, & Co., is given in the Pottsville Journal, as a "Model" establishment which it gives us much pleasure to lay before our readers.

The names of the gentlemen composing this enterprising firm, whose operations extend throughout this region, are Col. D. P. Brown of Pottsville, Major William W. Brown of Oak Hill, and Thomas I. Atwood, Esq., of Pottsville.

It would require a volume to describe minutely this Mammoth Breaker with all its various details. If we give a general description, it will be as much as the public can expect of us at present.

The building is 80 feet wide by 300 feet in length, from the end of the Lump Coal Shute to the Plane house, and 90 feet in height, from the main railroad to the top of the building, or 66 feet to the dumping tips. The entire establishment being under one continuous roof, weather-boarded from top to bottom, whitewashed or painted with a new and simple fire-proof and weather-proof composition.

Fifty feet of height is sufficient for a very large Breaking establishment; but to gain every facility which the advantage of height can bestow, and not go beyond the bounds of proportion, strength and durability, this stupendous Breaker with all its preliminaries and connections, from dumping tips to top of cars on main road, is only 60 feet in height.

The plane for hoisting to Breaker, is about 120 feet long with double track, and double acting "dumping trucks," at an angle of about 40 degrees—less than which, dumping trucks cannot well be made to answer the purpose for which they are intended. These trucks are an improvement on the original plans of both Brown and Cleaver, and the mode of returning the cars and trucks from the tips, is new and simple. One man, who attends to the *cones*, throwing them in and out of gear, can hoist 1,000 tons of coal per day without

leaving his post. The door is opened by the "half moons" or *circles*, for the purpose; and by reversing the cones, the wagons or cars return without resistance. On this principle the *inclined plane* is equal, if not superior to the perpendicular mode of hoisting, now being made use of at some of the new Breakers at Shamokin, Ashland and elsewhere.

The coal on being dumped out of the car, passes over a flat cast iron bar screen, leaving out steamboat coal and all which is less. That which passes the screen is examined by "*slate pickers*" and reserved for lump coal, or passed through the Breakers as the wants of the trade may demand. That part of the coal which passes through the flat screens, again passes over perforated plates, for the purpose of taking out the steamboat coal and *flat* and *long* pieces, which passes through the second pair of rollers, being previously cleaned of impurities, as far as possible, by slate pickers, who are stationed above the second or small rollers for the purpose. The remainder after being cleansed from dirt, which passes down into the "dirt hopper," is carried by shutes into huge circular screens for broken coal; and the egg, stove, and chestnut which passes through these meshes are carried into the great separating screens below.

Thus it will be observed that no coal goes into the first pair of rollers, which are 30 inches in diameter and 8 feet long, but that which is above steamboat size, and none through the second pair—which are 15 inches in diameter, and run at the rate of 120 revolutions per minute—less than broken coal size, except that which goes through the upper rollers; and consequently, as little waste is occasioned as possible. Another great advantage is, that much more coal can be put through in the same amount of time, than on the old system, when every thing went through the Breaker—*slate*, *bone*, *small* coal, and *dirt*. The broken coal screens are also an improvement over the old plan of operating. They are four feet in diameter and about ten feet long, both emptying into the centre bin, which is larger than the other bins, and runs up between the *two* sets of Breakers. These screens, it will be understood, only take out the broken coal, relieving the great separating screens of the weight, and consequently, the friction this coal would occasion by passing among the smaller sizes through the entire length of the screens. These screens were built by H. L. Cake of Tamaqua.

This is a double Breaker in every sense of the term, with four sets of rollers—two large ones and two small ones forming a set—the coal from each passing into their respective screens and bins, with the exception of the broken coal, which is emptied from both broken coal screens into one—the centre bin.

The two long separating screens are each 18 feet in length, with "Jackets," or outside screens 8 feet in length, or nearly half the length of the screens; which gives 9 feet for the separation of each kind of coal—or 26 feet for three kinds—egg, stove and chestnut. Formerly, 20 feet screens were used to make four and five kinds of coal. The principle upon which these screens are erected, gives double screen capacity, with only a short and a long screen; and 1,000 tons of coal can be put through the two sets per day as easily as 500 formerly.

Pea coal screens will be also erected for the purpose of supplying the 6 engines, which are to be used at the "Price Wetherill" and the "Oak Hill" Collieries.

There appears to be "good times" coming for "slate pickers" in this region, or at least there will be a good demand for *boys* and *cripples*, whose peculiar office, in the preparation of coal, is to pick slate. Formerly we sent the coal as it came from the mines—lump and fine—to the cities, and coal-breaking was then done by hand on the wharves or in the cellars; but now, we not only prepare the coal to the right sizes at the mines, but we also keep our plate, bone and dirt at home; for the *city folks* are beginning to find out that these things are not *coal*.

D. P. Brown & Co., can accommodate over 80 *slate pickers*, and 2 *slate bosses* at the "Price Wetherill Colliery;" the insignia of the bosses being a young hickory; or such are the rods with which they sway at some of the Collieries, which we have recently visited. But fortunately, it will scarcely ever be necessary to employ so many slate pickers at this Colliery, for the plan of operation, or digging coal in the mines is such, that most of the *impurities will be rejected there*, and at the platform below the dumping tips, before it passes through the Breaker. The veins on which this Colliery is established are generally pure, particularly the orchard and the Peach Orchard veins. At present, they are only opening on the coal; driving slopes, gangways, headings, &c.; and their coal is wet, unprepossessing, and not so pure as it will be when they are in full operation, with all their new improvements in machinery, and reforms in mining and preparing, which will be at an early day.

The bins will hold when level full 1500 tons of prepared coal, and including the lump coal shutes, 2000 *tons of coal can be stocked ready for shipment at any moment.* The "telegraphs" are so constructed, that they will fill the bins level full from one end to the other, without attention or assistance, and yet they are so flat, that while the coal will slide down rapidly, slate which is more dense, rough and adhesive, will not slide down unless forced, by the coal; therefore, should any of the slate pickers be careless of their duty, these telegraphs will *report.*

No pains or cost have been spared, not only to make this a *model colliery*, as far as improvements and appearances are concerned, but also to make the coal perfectly clean from slate and dirt: for this purpose every convenience has been made for the purpose of picking slate, and screens are inserted wherever they would be available, to make the coal perfectly clean.

The entire structure rests on high stone foundations, in which are embedded many hundred tons of stone: the consequence of this is, that the works rest on a solid, immovable foundation, and all the wood-work is raised sufficiently high above the earth and coal-dirt, to insure it from premature destruction by decomposition from water and the absorption of moisture.

The Breaker, hoisting machinery and screens, are all driven by two 20-horse power engines, and attached by a long gum belt passing over a large fly-wheel, and other connecting belts passing over pulleys, which gives motion to the enormous mass of iron in the shape of pulleys, cog-wheels, shafts and screens, that compose this mammoth concern.

The Breaker engines were made by John L. Pott, at the Orchard Iron Works in this place, and are governed by J. P. Pitche's water, or spiral governors, which so regulates the steam, that without the attention or assistance of the engineer, the power is increased or decreased, as occasion may require. The boilers are 18 feet immediately beneath the engines, and four in number.

The stack is 65 feet in height, and is built in the most graceful and beautiful proportion from bottom to top. Indeed every thing about the establishment seems to be constructed with as much *grace*, as strength and durability.

What is claimed in the construction of this Breaker over that of others, is the combination of grace, strength, utility, and durability. Every convenience which modern improvement and invention could devise, for the purpose of lessening labor, increasing facilities, and purifying the coal, has been made use of; and the result has been, that nearly all the work of preparing the Coal into sizes and cleaning it, with the exception of slate picking, is done by machinery. One thousand tons of coal can be prepared with the same number of men as it would take under the old system, generally made use of in this region some years ago, to prepare one hundred tons.

The large and small rollers, and the separating of the coal before passing through them, with the broken coal screens, are the inventions of the Messrs. Browns, and are generally known as "Brown's small rollers and screens." They are not generally in use throughout the region, but the advantages which

they possess over the old style are so great, that it must commend them in time to all our operators.

Another thing which is too generally overlooked, but which is made use of here, is the combination of the drum gearing for hoisting. The outside of the drum is connected with the drum wheels; which is about the diameter of the drum; with which the pinions work on the outside; thus giving the power when the weight bears, and saving the stress, or leverage on the drum shaft. It is a principle upon which all heavy work of the kind should be constructed if possible.

Having given a general description, as we promised, of this mammoth and model Breaker, we will make a few remarks about the rest of the establishment; but as they are not yet completed, we shall have for the time to make them as short as possible, but promise our readers more when these extensive works are in operation.

Messrs. D. P. Brown & Co., are sinking two slopes on the same vein (Primrose), parallel to each other, one of which is 100 yards in depth and the other is to be 200 yards deep. These two slopes—the one a downcast and the other an upcast slope with furnace—is to insure a perfect system of ventilation, and is on the only principle which science and experience have proved to be worthy of adoption.

Besides the vein on which the slopes are sunk, they intend to tunnel south to three others—all splendid red ash veins—which will give them, with the two lifts, 12 gangways, 6 to East and 6 to West; averaging 1½ miles each of a run. The Primrose vein produces some of the best coal in the region for locomotive and smith purposes: of the others we need make no remark, as their qualities are known to be good. They have two engine houses, and two engines for pumping and hoisting their coal. One of them for pumping and hoisting is a 90-horse, and the other for hoisting alone, out of the deep slope, is a 50 horse engine. The drum worked by this engine is 10 feet in diameter, and is calculated to hoist a car per minute.

The total cost of the entire establishment when completed, will not be less than $150,000.

LEHIGH COAL AND NAVIGATION COMPANY.

The following Report of this Company, made in April last for the preceding year, is the first which has appeared in these pages, and as it presents a full summary of their operations, we insert it entire:—

In the discharge of their duty to the Stockholders, the Board of Managers submit the following Report:

In the spring of the year 1854, the Company's navigation, after having been thoroughly repaired, was opened ready for business on the Lower Section, on the 10th of March of that year; and on the Upper Section on the 25th of the same month.

A return of severely cold weather, the freezing over of some of the levels and pools, and difficulties between the boatmen and the shippers upon the subject of freights, retarded shipments of coal, which did not become active until about the 15th of April.

The navigation closed prematurely, and very unexpectedly, on the 2d of December.

Notwithstanding a drought of extraordinary duration and severity, the navigation was well sustained throughout the season, and little or no interruption to business occurred on the Company's works.

On the Delaware Division of the Pennsylvania Canal, navigation was suspended from the 29th of April to the 19th of May, both inclusive; and again for six days in November.

These interruptions were occasioned by breaches from high water opera-

ting upon the Canal banks of insufficient height, and not adequately protected by slope walls and by paving. The State work (with great capabilities almost wholly neglected and unimproved) remains in the same unsatisfactory condition as heretofore.

Notwithstanding the obstacles thus opposed to the successful prosecution of business in the Lehigh region, the shipments of coal for the year 1854 reached to within a very few tons of the highest estimated production.

They were as follows:—

	Tons.
From the Company's Summit Mines,	413,049
" Room Run "	92,138
" East Lehigh "	10,731
Total from the Company's Mines,	515,918
From the Beaver Meadow Mines,	54,203
" East Sugar Loaf "	60,623
" Spring Mountain "	147,745
" Colerain "	85,347
" Hazleton "	144,215
" Cranberry "	68,899
" Diamond "	43,481
" New York "	15,422
" German "	4,022
" Buck Mountain "	66,617
" Wilkesbarre Coal Co's Mines,	89,232
" A. Lathrop (Pea Coal),	694
Making the whole quantity shipped,	1,246,418

To the above is to be added 28,660 tons from the Company's F. vein, leased to the Messrs. J. & R. Carter, and 233 tons taken from their Tamaqua mines by the Messrs. Roberts & Pascoe. These last-named mines have been leased for a term of years to Mr. Levan, whose preparations for taking out coal on an extensive scale are nearly completed.

The "East Lehigh" mines, formerly known as the *Old Tunnel*, leased for a term of years to Mr. Lentz, promise to be among the most productive and valuable operations on the Company's property.

The distribution of the coal shipped on the Company's Navigation was as follows:—

	Tons.
Consumed on the line of the Lehigh,	243,825
Passed into the Morris Canal,	267,864
Entered the Delaware Division,	734,729

Of the quantity which entered the Delaware Division, about 530,000 tons reached Bristol; about 170,000 tons passed out at the outlet lock at Wells' Falls; the remainder (about 35,000 tons) was consumed on the line of the Delaware Canal.

Shipments of lumber, for the year 1854, reached fifty millions of feet.

The amount of freight of every kind, transported during the year, on the Lehigh Canal, was as follows:

Descending,	1,398,638
Ascending,	120,644
Total,	1,519,282

being an increase of 173,055 tons, over the tonnage of 1853.

The following is the freight list for 1854:—

FREIGHT TRANSPORTED ON THE LEHIGH CANAL IN 1854.

	Descending.		*Ascending.*		*Total.*	
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.
Anthracite Coal,	1,246,592	08	511	01	1,247,103	09
Bituminous,			820	17	820	17
Charcoal,			82	18	82	18
Grain,	333	11	2,390	12	2,724	03
Flour,	951		1,131	14	2,082	14
Salt,			815	18	815	18
Salt Fish, Beef and Pork,	15	01	664	05	679	06
Other Provisions,	10	14	159	17	170	11
Beer, Porter and Cider,	15	11	55	07	70	18
Whiskey,	1,049	18	179		1,228	18
Hay and Straw,	30	01	802	14	832	15
Staves, Hoop-poles, Posts and Rails,	44	05	50	15	95	
Lumber,	51,723	12	2,112	01	53,835	13
Cordwood,	860				860	
Brick,	100	05	3,518	10	3,618	15
Slate,	4,590	18	203	10	4,794	08
Lime and Limestone,	28,482	09	6,042		34,524	09
Other Stone and Plaster,	2,717	16	2,470	17	5,188	13
Iron,	51,750	09	6,774	13	58,525	02
Iron Ore,	7,874	13	87,813	17	95,688	10
Pitch, Tar and Rosin,			149	13	149	13
Merchandise,	1,495	18	4,899		6,394	18
	1,398,633	09	120,648	19	1,519,282	08

From the preceding statements, it will be inferred that the results of the year's business were of a highly satisfactory character. This inference is borne out by the following more detailed exhibit.

The profits *for the year* 1854 were, from ground and water rents and from lots sold, $26,733 94; from coal, $378,821 30; from tolls, $685,097 51; making a total of $1,090,652 75: showing a slight falling off in the first item, a large excess in both the others, and an increase of $285,937 53 in the sum of these items, over that of the corresponding items for the year 1853.

The balance *for the year*, to the credit of profit and loss, after providing for State tax, interest, repairs and expenses, is $673,660 80; showing an excess of $297,859 69 over the balance for the preceding year.

During the year 1854, the capital stock was increased by $488,750; the funded debt was diminished by $469,175 79; the floating debt was increased by $41,101 11; and the general indebtedness of the Company was reduced by $435,982 05.

The assets comprise, at this time, April 25, the following items, forming the contingent fund, held in trust, and subject to the orders of the Board of Managers, viz.

Pennsylvania State Fives,	$400,000 00
" Sixes,	10,000 00
City Sixes,	74,000 00
Pennsylvania R. R., 2d Mortgage Bonds,	200,000 00
Lehigh Valley R. R. Mortgage Bonds,	16,000 00
Lehigh Coal and Navigation Co's Sixes,	511,303 30
Making an aggregate of	$1,211,303 30

On the first day of January last the whole amount of the Company's liabilities, including capital stock, funded debt, and obligations of every kind, and including also their own loans held in trust as above stated, was $7,329,500 60.

The financial condition of the Company is more fully stated in the accompanying accounts herewith submitted.

During the year two dividends, of 8 per cent. each, were paid upon the capital stock.

For the present season the production of coal from the Lehigh region will depend, as it did in 1854, upon the boating force, and upon the trade being exempt from interruptions. The supply of boatmen has been much improved; but notwithstanding that contracts were invited for building a very consider-

able number of boats, no very material increase has been effected. Should no disasters to the navigation occur, the quantity of coal sent to market will probably be not less than 1,250,000 tons. Nearly the whole of this has been sold at fair remunerating prices. What little remains on the market is held at advanced rates.

The expenditures upon the Company's works during the year 1854, were somewhat increased by the high rates of labor and of materials. From the accompanying Report of the Company's Engineer, it will be seen that important and very desirable improvements have been made, in increasing the depth of water in the canal, in rebuilding and enlarging some of the locks, in the substitution of drop gates for swing gates, in strengthening the banks, and in the construction of more than ten miles of towing path on the *berm* side of the canal. It is not the intention of the Board of Managers to rest satisfied with the improved condition of the Company's navigation, now in a higher state of completeness and efficiency than at any former period. It is their purpose to persevere, and by furnishing increased facilities to business, and for the quick transport of commodities, to make the work more and more deserving of the public favor.

It is a great misfortune for the region, and much to be regretted, that the favorable results naturally and confidently to be expected from the improved condition of the Company's navigation, are in a measure neutralized by the very inferior character of the accommodations and facilities offered on the Delaware Division of the Pennsylvania Canal; forming as it does practically, a prolongation of the Lehigh Canal, and constituting the connecting link between it and the magnificent navigation of the Delaware and Raritan Canal Company. In regard to this portion of the State improvements, we are obliged to reiterate the oft-repeated statement of insufficient depth of water—of contracted and unsafely constructed aqueducts and locks—of banks and towing paths inadequately supplied with overfalls, imperfectly and partially protected by slope walls and by paving, and so little raised above the surface of the water in the levels, as to be liable to be overflowed and breached by every passing summer shower; and of a supply of water, at some seasons, dependent upon a ricketty and rotten water-wheel.

These defects in the canal, obvious to the most casual observation, and in their consequences so disastrous to the trade of the region, have been strongly and prominently brought to the notice of those in charge of the public works. As yet they have been but very partially and imperfectly remedied. It is so difficult to conceive of any valid reasons for a persistence in a system which would subject an incorporated company or an association of individuals, to the severest censure, that it seems not unreasonable to hope that the State must, sooner or later, be induced to adopt a policy more in accordance with her own interests, and with the reasonable claims and expectations of the public. The expenditure by the State of a sum moderate in itself, and insignificant in reference either to the objects to be accomplished or to the resources of the Commonwealth, if judiciously applied to increasing the depth of water to six feet, and to protecting and strengthening the canal banks, would add at least a third to its present capacity, reduce the cost of movement, and secure the trade against those interruptions from which it has heretofore so frequently and so severely suffered.

The Lower Section of the Company's canal was ready for the admission of the water about the middle of March of the present year, and the Upper Section on the 25th of the same month. But, in consequence of the prolonged severity of the weather, and the obstructions from ice, the navigation was not open to Mauch Chunk before the 30th of that month; and it was not until the 14th of April, that the boats forced their way through to White Haven.

On the 4th of April, the loading of boats at Mauch Chunk began; and since then, notwithstanding the suspension for several days of navigation on the Delaware Canal, from leaks and from the tumbling down of a slope wall, and subsequently of a wharf on the line of the canal, shipments of coal have been steadily increasing.

Summary of the Liabilities and Assets of the Lehigh Coal and Navigation Company—Jan. 1, 1848, to Jan. 1, 1855.

LIABILITIES.	Jan. 1, 1848.	Jan. 1, 1849.	Jan. 1, 1850.	Jan. 1, 1851.	Jan. 1, 1852.	Jan. 1, 1853.	Jan. 1, 1854.	Jan. 1, 1855.
Capital Stock,	1,508,550 00	1,508,550 00	1,508,550 00	1,508,550 00	1,508,550 00	1,569,800 00	1,985,850 00	2,474,600 00
Common Loans,	3,688,235 84	3,686,856 98	3,685,183 83	3,688,881 85	4,346,077 86	4,358,827 12	4,050,558 89	3,586,078 10
Mortgage Loan,	946,808 56	1,000,000 00	1,000,000 00	1,000,000 00	1,000,000 00	929,342 00	837,492 00	882,792 00
Floating Debt,	840,075 86	446,982 80	289,046 68	888,765 48	588,883 89	864,983 10	832,049 10	878,150 21
Unpaid Dividends,	798 70	798 70	798 70	798 70	798 70	8,823 70	8,508 95	4,285 70
Arrears of Interest,	867,095 48	873,941 27	824,174 65	689,874 81	99,085 89	74,812 89	67,283 71	58,634 59
	7,846,563 44	7,512,129 20	7,252,708 86	7,216,320 79	7,538,845 34	7,296,588 81	7,276,782 65	7,829,500 60
Balance to the credit of Profit and Loss account,	291,633 86	367,691 18	565,671 35	706,172 96	777,337 24	907,995 25	1,164,672 36	1,689,954 66*
	7,638,197 30	7,879,820 38	7,818,375 21	7,922,493 75	8,315,682 58	8,204,584 06	8,441,405 01	9,019,445 26
ASSETS.								
Canal and River Improvements,	4,455,000 00	4,455,000 00	4,455,000 00	4,455,000 00	4,455,000 00	4,455,000 00	4,455,000 00	4,455,000 00
Lehigh and Susquehanna Rail-road,	1,369,820 75	1,380,798 00	1,880,000 00	1,880,000 00	1,880,000 00	1,880,000 00	1,880,000 00	1,880,000 00
Real Estate, cost of coal mine lands and other lands, Rail-roads to the several mines of the Company, and other improvements, Wharves and Landings at Philadelphia, &c.	1,198,044 48	1,824,285 69	1,837,289 98	1,858,528 01	1,847,248 77	1,807,876 55	1,280,998 17	1,281,901 46
Movable effects, Debts due the Company, Bonds and Mortgages, and other securities,	612,475 58	712,246 33	635,520 84	717,090 30	1,108,301 47	1,012,927 68	1,249,910 11	1,845,897 23
Cash on hand,	7,856 54	7,540 36	10,564 44	16,875 44	30,182 84	48,729 83	75 496 73	57,156 57
	7,638,197 30	7,879,820 38	7,818,375 21	7,922,493 75	8,315,682 58	8,204,584 06	8,441,405 01	9,019,455 26

* Of the balance which appears to the credit of the Profit and Loss account, about $1,100,000 is now, April 25, 1855, invested in the name of Trustees, as a contingent fund. Of this sum, over $500,000 is invested in the loans of the Company, and the rest in other loans and available securities, the whole being included among the assets. Of the remainder of the balance standing to the credit of Profit and Loss, a large sum has been expended in improvements of the Company's Real Estate.

COAL VS. WOOD.

Professor Haswell, late Engineer in Chief in the United States Navy, puts down 1 lb. of Coal as equal to 2¼ and 2¾ lbs. of Wood in generating steam.

Cubit feet required to store Coal, Coke, and Wood;

1 ton of Anthracite Coal, ...	44
1 ton of Coke, ...	80
1 ton of Wood, ...	107

BRECKENRIDGE COAL.

This coal is now sold at about $15 per ton, for the extraction of oil contained in it. The yield of a single ton is estimated at seventy gallons, worth $1 per gallon.

MICHIGAN COAL COMPANY.

We understand that this enterprising Company is now fully organized under the General Law of the State, and that they intend as fast as means can be obtained, to prosecute active mining operations, to supply our city and state with coal of native Michigan growth. Three extensive coal fields, embracing some thirteen hundred acres, have been purchased—one upon the Central Road; one upon the Detroit and Milwaukee Railroad, and one upon the Detroit and Lansing Plank road—all eligibly located for the shipment to the cities and villages of the interior, and to the eastern or western lake ports of the State. These several coal fields have recently been explored by a practical, scientific gentleman, Mr. A. G. Bradford, of Pennsylvania, who, for the past fifteen years, has made coal explorations and locations, in Pennsylvania, Ohio, Maryland, Virginia, &c., &c., his entire business.

After spending some two weeks in making the most thorough examinations of the Michigan Coal Company's fields, and testing the quality of the coal, and the advantages offered, in working them, he has made a report to the Board of Directors, a copy of which has been laid before us.

Mr. B., says "the field on the Michigan Central Railroad exhibits one seam or strata of coal, from three to four feet thick, of a very excellent quality," and "surface indications of two other seams in the same basin, the whole extending over several hundred acres," and that "the coal is highly impregnated with bitumen, and will yield a quality of both gas and coke, at least equal if not superior to any coal of which I have any knowledge in the United States."

Of the Company's Coal field on the Detroit and Lansing Plank Road Mr. B. says: "I found the out-crop had been cleared of its superincumbent material, and exhibited a coal seam or strata of about three feet in thickness. The coal is of remarkably good quality, and its color of a high jet black; it is in block, and dips into rock," &c.

Of the Company's field on the Detroit and Milwaukee Railroad, he says: "Here I found an out-crop of a seam of bituminous coal, three and a half to four feet thick, and discovered indications of two other seams in the same basin. This coal is of a dark lustre, pure and compact in blocks. This field contains one of the most valuable deposits of coal I have ever seen in the United States." Want of room forbids our giving the valuable report alluded to in full.

Mr. B. closes his report by saying, "I may add in general, as to these coal localities, that the coal found at each place is of extraordinary purity, approaching in quality 'cannel coal,' (the very best of coal for gas or coke, and hence for any other use,) blending in its component parts all the necessary elements for every variety of use. From my coal exploration in several States of the Union, to which I have devoted the most of my attention for the last fifteen years of my life, I can safely say, that I never saw coal at the out-crop of such extraordinary quality and purity, and so free generally from sulphur and other impurities."

The very large and increasing demand for mineral coal in this city, and indeed, in every part of the State, renders the working of our native coal mines of great public importance. Few, we apprehend, are aware of the enormous amount of money annually sent out of the State for this one article. From statistics obtained, we are satisfied that not less than $600,000 to $700,000 will, the present year, be sent out of the State, for mineral coal used in navigation, manufacturing and domestic purposes within its borders. And this, too, with the known fact, that we have native coal, equally good, if not better, easy of access, and of almost unlimited extent, which can be obtained for the digging, at a cost of at least 10 to 20 per cent. less than the foreign article, and, even at the highest reduction, afford an annual profit upon the capital invested of from 30 to 40 per cent. It seems almost incredible that our citizens have not turned their attention to this subject before; but, we presume that, in this, as in other cases of similar important local public enterprises, they are waiting for foreign, non-resident capital to absorb the profits of local enterprises which should accrue to resident capitalists.

WORKING SHAFTS.

A sketch of a shaft for mining coal under the English method was presented in the last volume of this magazine; we add to the details there given a description of the manner in which coal is raised from shafts in England, by a correspondent of the Pottsville Journal, which will render more clear our former illustration:—

The method of conducting mining operations in the English Coal districts is so different from the manner in which such are carried on in Pennsylvania, in consequence chiefly of causes that may be traced to the relative newness of our country, and want of capital in our proprietors, that a brief description of one of the Lancashire mines which I was generously allowed to inspect by the proprietors, Messrs. Knowles & Son, may not be uninteresting to your readers. The Pendlebury colliery between Manchester and Bolton, is one of an extensive series worked by the Messrs. Knowles in various parts of the country; this firm being probably one of the largest coal miners in Lancashire. The pits, of which there are two, fifty feet apart, with the engine-house between, are no less than *one thousand two hundred feet* in depth, and the underground workings extend over an area of *one half a square mile.* A high-pressure engine of 100 horse-power, the steam of which is supplied from three long cylinder boilers rigged up with checks, gauges and safety-valves, to a degree that would astound the captain of a western river steamboat, works the gins by which the coal is raised to the surface from this vast depth. The rope, which is flat, and composed of iron-wire plaited together and well tarred, emerges from the windlass around which it is wrapped, to the shafts at opposite sides of the engine building, upon rollers erected on a high framework, that extends from the windlass to a point directly over the pits. Thus while one bucket is descending empty in the downcast shaft, a loaded one is ascending in the upcast shaft. A counterbalance of five or six hundredweight is also attached at a few yards remove, for the purpose of rendering the upward and downward motion uniform, and of aiding in the ascent. This it accomplishes by lending the whole force of its gravity when the bucket is at the bottom, and as it rises, this gravity is gradually decreased by the sinking of the counterbalance. The first thing which attracts the visitor's notice, is the perfect system and efficiency that attends the delivery of the coal from the mine and its despatch from the premises. The cast iron pavement on which he is standing is raised five or six feet above the yard, into which the wagons are driven to be loaded, and the little cars are wheeled from the mouth of the pit to revolving "corves" at the edge of the paving, by whose aid their freight is quickly and neatly precipitated into the wagons that stand ready to receive it. These, and the other admirable surface arrangements adapted to the delivery in an orderly manner of

between three and five hundred tons daily, I had time to glance at; whilst my cicerone, the intelligent superintendent of underground operations, was oiling and lighting the lamps with which we were to make our subterranean exploration at a depth of several hundred feet below the level of the sea. The manner of our descent to this depth was more like a long ride on the piston of a steam engine than the common idea of mine descending in our country, including as it does all the items of swaying from side to side, at peril of braining one's self against the pit-walls and the risk of receiving a quietus, from an overhanging rock in the upward-bound bucket. Guides with deep grooves into which fit projections from the descending car allowed us to slide down so easily that the motion was hardly felt, and the car, occupyin the fu l cross-sect'on of the mine, entirely removed the risk from falling bodies. When we arrived at the bottom, instead of finding a dirty, muddy area, with water dripping from every inch of roof, we stepped out as comfortably as one would from a handsome cab, into a large hall, arched over at a good height above us, and flagged under our feet with a perfectly clean and dry cast iron pavement, that would not disgrace the sidewalks of Broadway. The place did not even appear to be damp, so admirably had the iron "tubbing," which lined the shaft from near the surface to within four hundred feet of the bottom, effected the drainage. "We are below the region of water," said my guide, and it indeed appeared to be so. Re-trimming our lamps, we then set about to explore the wonders of these subterranean galleries. From the great hall opened in one direction an avenue that led to the stables—two ponies were here contentedly chewing their cud; and contented they had reason to be, for their apartments exhibited a degree of comfort, hollowed as they were out of the solid rock, that many daylight ponies would be happy to be furnished with, at any risk of fire-damp or other accident incident to a life in the mines. There were stalls and mangers for a dozen other ponies who were on duty. Four main avenues or "levels" led off from the foot of the shaft in as many different directions. One of the two that ran in the direction of the strike of the strata, we set off upon, and followed a line of railroad for a quarter of a mile, when stopping to take breath, and examine the beautiful fossil trees and forms with which the roof was studded, I was told that the road we were on was three thousand and three hundred feet, or two thirds of a mile long; and that the other level, running in an opposite course from the shaft, was of the same length. The north and south roads, which were excavated to reach the three other veins of less width lying above and below us, were over a quarter of a mile long. From these figures, the reader may possibly derive some idea of the extent of these subterranean workings; but the length and breadth need to be walked over on a warm July day, in the somewhat close air of the coal mine, before we can have a proper appreciation of the area. "Mind you, we are not going to make the entire circuit of this farm this morning," observed the superintendent as we set off again along the east level, "else we shall have a walk of ten or fifteen miles on our hands." I assented, as the bare proposal to walk nine and a half miles further in such a place was enough alone to make one grow weary. The great depth, the vast extent and innumerable galleries and passages of these mines, render the utmost attention to the subject of ventilation necessary to supply the collier with proper air while working; and to insure him against the injurious effects of the fire-damp, which will *not* explode when mixed with a certain high proportion of atmospheric air. The usual mode of accomplishing this, as is well known, is by having two pits, a downcast and an upcast pit, and by means of a fire built under the latter, to so alternate the air in it, that the equilibrium between the two columns of air shall be destroyed, and a perpetual current be the result, setting down the cold shaft where it is of course heaviest, and up the warm shaft where it is expanded and consequently lighter. In pits which are not driven to any great depth, it is found that very slight causes are sufficient to destroy the equilibrium, and set in force the action of the air's gravity to produce the desired current; thus the greater number of workmen in one pit than the other, by their

breaths and the heat of their bodies will produce the effect; or if powder is used, the greater frequency of blasts in the upcast shaft than in the downcast one, may be an equally potent cause in insuring the ventilation. But in mines such as those in this part of Lancashire, a large furnace burning from a half ton to a ton of coal per day of 24 hours, becomes necessary, to destroy the equilibrium of the two columns, and give the mine sufficient ventilation to dilute any gas that may arise, and prevent it from exploding.

IRON AND ZINC.

WHITE OXIDE OF ZINC, AND INSTRUCTIONS FOR ITS USE.*

Varnishing over Zinc Paint.

All kinds of varnish may be laid on zinc paint. If two coats are intended, let the first dry well before laying the second.

Zinc Paint in Varnish.

This paint is made by adding turpentine or alcohol varnish to the zinc ground in oil, without any additional quantity of oil; its use requires promptness and practice, as this mixture is liable soon to become hard and dry. Turpentine varnish is preferred to alcohol, as it costs less, becomes harder after being put on, and lasts longer. It has been ascertained that the mixture of zinc paint in varnish remains in a liquid state longer than a similar mixture with white lead, and can be used several hours after mixing.

Admixture of Zinc with Colors.

Oxide of zinc combines to perfection with all colors used in painting. Colors which have a lead basis, should be avoided for fear that, being decomposed by the air, they might destroy the good qualities of the zinc.

Proportions for Mixing.

For light gray	100 parts 1 "	White zinc. Coal black.
Slate gray	1 part 1 "	W. Z. Gray oxide.
Blue black gray		pure Gray oxide.
Vineous gray	100 parts 1 "	White zinc. Van Dyk brown.
Sky blue or bluish white	100 parts 1 "	W. Z. Indigo.
Stone color	15 parts 1 "	W. Z. Yellow ochre.
Straw color	40 parts 1 "	W. Z. Yellow chrome.
Chamois	81 parts 1 " 1 "	W. Z. Yellow ochre. Vermilion.
Dark Chamois	10 parts 1 "	W. Z. Sienna.
Citron color	40 parts 1 "	W. Z. Dark yellow ochre.
Gold color	10 parts ½ " 1 "	W. Z. Yellow ochre. Dark Yellow ochre.
Cream color	20 parts 1 "	W. Z. Burnt Sienna.
Dark Walnut color	10 parts 1 " ½ "	W. Z. Burnt umber. Red ochre.

* Continued from page 191.—Vol. V.

Rose	10	parts	W. Z.
	1	"	Madder lac-dye.
Lilac	15	parts	W. Z.
	1	"	Madder lac-dye.
	1-16	"	Prussian blue.
Mahogany	15	parts	W. Z.
	1	"	Burnt sienna.
	2	"	Mineral orange.
Olive green	2	parts	W. Z.
	1	"	Yellow ochre.
	½	"	Lampblack.
Chocolate color	4	parts	W. Z.
	1	"	Prussian red.
	1	"	Black.
Light do	10	parts	W. Z.
	1-10	"	Umber, new.
	1-10	"	Prussian Red.

It is hardly necessary to remark, that by being mixed with white oxide of zinc, all the above coloring materials acquire additional brightness and durability.

THE PRODUCTIONS OF ENGLISH IRON FURNACES.

We subjoin two tables, each compiled with great care, of the statistics of British furnaces. The first by Robert Hunt, F.R.S., under the direction of the Treasury Commissioners, gives the number in blast last year, with their actual produce; the second table gives the number of furnaces in existence this year, whether in blast or not, with the amount of pig iron which they are capable of producing, if all in operation.

Table 1st.

A summary of the Iron Furnaces in blast in England, Scotland, and Wales, in 1854:—

Works.	Districts.	Furnaces in blast.
23	Northumberland and Durham	59
14	Yorkshire	21
18	Derbyshire	25
1	Cumberland	2
1	Lancashire	1
7	North Staffordshire	21
65	South Staffordshire	145
18	Shropshire	28
7	Denbighshire	9
14	Glamorganshire (A)	21
34	Ditto and Monmouthshire	100
4	Gloucestershire	5
9	Ayrshire	30
13	Lanarkshire	72
4	Fifeshire	9
1	Linlithgowshire	2
2	Stirlingshire	2
1	Clackmannanshire	2
1	Dumbartonshire	1
1	Haddingtonshire	0
Total 228 works.	Furnaces in blast	555

Total produce of pig iron in Great Britain in 1854:—

Northumberland, Durham, and North Yorkshire ... Tons	275,000
Cumberland and Lancashire	20,000
Yorkshire	73,444
Derbyshire	127,500
Staffordshire	817,000
Shropshire	124,800
Flintshire	32,900
South Wales	750,000
Gloucestershire	21,990
Scotland	796,604
al	3,069,838

Table 2d.

Number of blast furnaces in Great Britain in 1855; their mean weekly produce, and gross annual production when under blast:—

District.	Number of furnaces.	Mean weekly produce of each furnace.	Annual production of crude iron.
South Wales	169	118....Tons	1,024,776
Ditto anthracite	37	72	189,880
Dean Forest, North Wales, and Lancashire	33	67	115,460
South Staffordshire	169	108	948,520
North Staffordshire	19	104	102,960
Derbyshire	30	101	158,080
Shropshire	34	86	151,720
Yorkshire	31	72	116,480
Northumberland	79	132	541,320
Scotland	145	155	1,082,540
Total	746	118	4,399,836

QUARRIES AND CLAYS.

A NEW BRICK.

Our readers will remember a notice in our paper some time ago, of a new style of brick, made of a mixture of sand and lime, compressed with great force into a mould of suitable shape. An objection has been raised, with some degree of plausibility, to this style of building material, on the ground that these brick will harden to only limited depth and not throughout their whole thickness. The objection may have some force in the case of brick manufactured late in the fall and frosty season; but we see no reason why crystallization should not take place in ordinary weather, as thoroughly in these bricks as in the walls of a gravel house, or in the joints of an ordinary rubble wall.

A gentleman experienced in the manufacture of this building material, thus explains the hardening process: "When the fact is more generally known, that in every 106 pounds of limestone, there are 44 pounds of carbonic acid, and that the process of burning this lime causes this carbon to pass off, and fits it for hydration (slacking), and when it is known that this remaining 56 pounds of sulphate of lime, when hydrated and mixed with sand or gravel, according to the quantity of each, has an affinity for carbon, and that one part in every hundred of the atmosphere is carbonic acid gas, the "*intelligent*" men will understand why it is that brick of such a compound, when subject to frost before becoming thoroughly dry, or if made with old lime, can never become very hard, while those made in the early part of the season, and through the summer, though tender, will do to be laid in three days after making, and become hard enough the same season, to bear the burden of not only 30 or 40 tons, but many times that amount if necessary, and, in a few years, instead of crumbling down, become equally hard as the several particles of sand or gravel of which they are made.

"When it is generally understood that the carbon in the atmosphere more readily communicates itself to the hydrated lime when moist, all men know why it is that every time it rains upon the brick, after being once thoroughly dry, only tends to make them harder when again dry.

"I have not seen Mr. F. since he made his discovery; neither do I know if these are his views. With me they are facts, obtained from ten years actual experience."—*Railroad Record.*

MISCELLANIES.

THE PROCESS OF EXTRACTING ALUMINUM.

We translate from an article by Mr. P. Blanchard, of Paris, the following account of this process:—

"We furnish from a compendious memorandum of M. Sainte-Claire-Deville, what we have been able to gather from a lecture hastily delivered at the Academy lately by M. Dumas, on the beautiful specimens of aluminum obtained by the young chemist of the Upper Normal School, at the manufactory of chemical productions belonging to the General Company of Javel, with the aid of funds furnished by the Emperor at the recommendation of the Academy.

"The thorough working of aluminum by means of the chloride of this metal and sodium, is, by general admission, a great acquisition to science. The author procured chloride of aluminum by causing the chlorine to react on a mixture of alumina and coal-tar, previously calcined. The operation was effected in a gas-retort with extraordinary facility and perfection. The result of M. Deville's observations is that the action of the chlorine is procured upon a layer of one, or at most, two decimeters of the mixture, so that the absorbtion of the gas is always complete.

"The condensation of chloride of aluminum is effected in a chamber of masonry lined with tiles. This chloride is so compact that it can be seen on the table, of considerable density and composed of yellow crystals. Very slightly ferruginous, it is purified completely during the process of extracting the aluminum, in which its vapor passes over iron filings heated to 400 degrees or thereabout. The sesqui-chloride of iron, as volatile as the chloride of aluminum, is changed by contact with the iron, and becomes comparatively very fixed. The vapor of the chloride of aluminum rising from the apparatus, forms colorless and very transparent crystals.

"Sodium is being prepared the meanwhile in large and small vessels with remarkable facility. Having studied with particular care the influence of temperature on the surfaces exposed to heat, and the activity of the vapor of sodium as it escapes from the apparatus, M. Deville is convinced that by properly regulating the relation between the heated surfaces and the section of tubes from which the sodium issues, one could procure this metal at a moderately high temperature, about that perhaps of the melting point of silver. Already even the cylinders are much less heated than are the vessels used in the manufacture of zinc. The author is now employed in producing sodium in continuous apparatus.

"As to the reaction of the chloride of aluminum upon the sodium, that is done in metallic tubes, the form and management of which are not yet sufficiently scientific. In this particular there is yet something deficient; but the skilful chemist has already decided upon a plan of experiment suitable to obviate these difficulties; and we do not doubt, after the complete successes so rapidly attained in his laboratory, that he will soon entirely overcome them.

"It will be remarked, undoubtedly, that in the details above, faithfully rendered from the account of M. Deville, there is no mention of the very reduced price which Messrs. Dumas and Balard have promised. It appears that, for the present at least, this price is still very high, and very far from being what would be considered the net cost, as stated by us conditionally, of the agents necessary to extract the aluminum. Moreover, M. Dumas has not explained himself formally concerning the price even of the new metal, and he has anticipated too much in this respect. Now, if sodium, which cost lately 1,000 francs a kilogramme, should rise thirty francs more, as it requires three times the quantity of that to extract a proportion of aluminum, it will be perceived that this latter article would not be so accessible as they would have it seem, not to mention other particulars which increase the expense.

"Still there is reason to believe that a factory of aluminum, established at Marseilles, turning to account the chlorine of muriatic acid, which is produced in superabundance, and the alumina of certain deposits in the vicinity, could offer this precious metal at a price sufficiently low to place it shortly among the more common ones.

"Scarcely has aluminum been ranked among metals, before, independently of the unexpected service it will render as such to the arts and sciences, it begins to figure as an electro chemical agent in a no less remarkable manner. The skilful director of the galvano-plastic department of the Mint, M. Hulot, submitted to the Academy through M. Dumas, some assays, in which this metal was substituted for platina as an electro-negative element in the piles to a single liquid.

"M. Hulot has succeeded, not without great difficulty, in rolling perfectly and without loss, an ingot of aluminum of thirty and some grammes, procured from one of the first meltings of this metal obtained by M. Rousseau—less white than at first, and containing traces of iron and silicium. A connection of aluminum and zinc amalgamated for a long time, charged with water acidulated with a twentieth of sulphuric acid at 66 degrees, disengaged during the first hours considerable hydrogen, and produced a current equal if not superior to that of a connection of platina and zinc excited to the same degree. The author asserts that the next day the electro-motive force of the pile was reduced nearly one quarter; but he remarks that it suffices to immerge the aluminum in nitric acid, or still better, as it appears, in muriatic acid—as it is expedient to effect it at once—to give to the circle its first force.

"As aluminum is nine times lighter than platina, and presents also a surface nine times more extended than the latter metal with an equal thickness, its substitution for platina should be productive of real advantages, above all now that its price has become very accessible. The aluminum here spoken of is very difficult to forge. In order to roll it, it has been found necessary to anneal it at each pass. By deposing copper electro-chemically on a plate of aluminum, they have succeeded by the aid of rollers in reducing it to very thin plates. Hard aluminum acquires by annealing an inflexibility which would make it of great use in the suspension of all kinds of scales for assays or analyses. This metal is so light that, the weights of the system being the same, the arms of the beam can be elongated a great deal, and long blades can be placed even on the extreme points of suspension, as on the centre of oscillation. The author does not doubt that in weighing twenty grammes, the sensibility of the balance would not rise a half-millionth."

MINERAL WEALTH OF ENGLAND.

On the authority of Mr. Robert Hunt, government keeper of the mineral records of England, the following statement is regarded as an approximation of the annual value of its mineral wealth:—

Coal raised at the pit's mouth,	£11,000,000
Iron,	10,000,000
Copper,	1,500,000
Lead,	1,000,000
Tin,	400,000
Silver,	210,000
Zinc,	10,000
Salt, Clay, etc.,	500,000
Total,	£24,620,000

This is the value of the raw material. When the cost of labor employed in converting this mass of matter into articles of utility or objects of ornament is added, it will be swelled a hundred fold.

CURIOUS DISCOVERY ON THE DESERT—SODA SPRINGS.

The party engaged in the survey of public lands under Mr. Pool, found at a point about fifty miles east of San Felique, in San Diego Co., a singular collection of fountains or springs of soda water, situated in a sandy plain or depression in the surface of the desert. The spring is in a mound of symmetrical shape, tapering like a sugar-loaf, in the centre of the top of which is a hole, unfathomable, containing the carbonated beverage, fresh from some natural laboratory below. Some of these mounds are six feet high, and clothed with a green and luxuriant coat of grass, while others are shaped like an inverted bowl, and fringed by a growth of cane. The water is described as having the same sparkling and effervescent property as that ordinarily sold by apothecaries, and was drank with avidity by both the men and animals belonging to the party. When impregnated with acid of any kind, it produced instant effervescence, and in that form is peculiarly refreshing as a drink. Some of it has been brought in in order to be chemically tested, with a view to make the discovery of some practical utility.

THE MINERALS OF TENNESSEE.

East Tennesseee, as we learn from the *Knoxville Whig*, is three hundred miles in length by one hundred in width, and embraces within its limits thirty counties. From Marion County to the county of Anderson, and beyond that for the distance of two hundred miles, stone coal, iron ore, lead and other valuable minerals abound in profusion. This region is watered by the Tennessee and Clinch Rivers, which are navigable for steamboats during nine months of the year. In Anderson, Campbell, Claiborne and Hawkins Counties, salt, coal and iron exisit in abundance. On the south side of the Holston River, discoveries are being made daily of iron, lead, silver, copper and coal. In Polk County twelve copper mines are in operation, most of which produce ore (so says our contemporary) of a quality richer than the mines of Lake Superior. For this ore $170 per ton is realized. The cost of transportation to New York is $21 50. The copper business is the most profitable in that section. During the month of April four of these mines shipped six hundred tons of ore—equivalent in value to $102,000.

THE GEOLOGICAL SURVEY.

The Superintendent of the Survey and his assistants have been operating during the last three weeks in Montague township, Sussex Co., and the investigations have revealed among other discoveries large deposits of *shell marl*, which will be of incalculable benefit for agricultural purposes on the sterile lands of that locality. The deposits cover hundreds of acres, lying about 15 feet in thickness. The upper layer is pure peat from 4 to 8 feet thick, next a stratum of fresh-water shells occurs, about 18 inches thick, and then the stratum of marl. The latter is almost pure carbonate of lime, which is well known to be one of the best agricultural fertilizers.—*Newark (N. J.) Daily.*

THE

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EDITED AND CONDUCTED BY

WILLIAM J. TENNEY.

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THE

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DEVOTED TO

Mines, Mining Operations, Metallurgy, &c., &c.

VOL. V.—OCTOBER, 1855.—No. IV.

ART. I.—THE MANAGEMENT OF COLLIERIES.*

YOUR committee have especially directed their inquiries to the state of the coal mines since the year 1849, in order to ascertain whether any and what improvements have taken place since that period, when a committee of the House of Lords sat and received evidence, which, with their report, was laid upon the table of your honorable House. In examining those witnesses who appeared before the committee of the House of Commons in 1852, your committee have endeavored, as much as possible, to follow up the investigations of that committee, believing that the late period of the session precluded more evidence being received on all the subjects which ought to be included in such an inquiry.

Your committee first proceeded to examine two gentlemen who were sent by the Home Secretary to Belgium and other parts of the Continent, with a view of inquiring into the state of mining, and of ascertaining the rules and regulations adopted in those countries. Their evidence was laid before your honorable House on the 30th of June, 1853. They reported that a very stringent and expensive system of inspection is adopted, more particularly in Belgium, where, next to this country, the most extensive coal mines are found. Your committee, however, are of opinion that such a system is not applicable to this country, because in Belgium and Prussia, the mines being the property of the Government, the duty of the inspectors is not only to insure the safety of the workmen, but also to ascertain the profits of each colliery, and to take care that the mine is worked in the best way to secure the largest income to their Government. Mechanical means of ventilation are for the most part used; but in no instance producing 40,000 cubic feet per minute, and in most cases not half that amount; and although some rules might be adopted with advantage, neither as regards management nor ventilation do your committee consider the system equal to that of the best regulated collieries in this country.

Having well weighed the evidence which has been published, your committee are of opinion that imperfect ventilation is the

* Report of a Committee to Parliament.

cause of the numerous accidents from fire-damp in this country, and that an abundant supply of pure air, properly distributed, must be considered as the great and effectual means of preventing explosions, and the consequent sacrifice of human life.

Your committee directed their attention to the various methods by which a supply of air might be obtained, with a view to determine their relative efficiency. Those which were brought under their notice may be stated under four heads,—viz., the furnace system, the steam-jet, mechanical means, and natural ventilation. They have had the result of various experiments laid before them, and have examined witnesses as to the merits of the different modes of ventilation above alluded to, and have to report that the preponderance of evidence is decidedly in favor of the furnace.

Your committee are aware that the committee of the House of Lords called attention to the steam-jet, and that the committee of the House of Commons in 1852 reported in favor of it; but since that time investigations and experiments on a much larger scale have been instituted by Mr. Nicholas Wood, and others, the results of which, together with the evidence before your committee, lead them to an opposite conclusion, and induce them to think that, especially where the coal lies at a considerable distance below the surface, and the shafts are consequently deep, the furnace is the most effective, as well as the most economical, mode of ventilation.

They have also taken the opinions of some of the most competent viewers and Government inspectors on the objections raised against the furnace. These were designated under the title of furnace limit, furnace paradox, and natural brattice; and they are led to the conclusion that these are theoretical views, and do not establish any positive law affecting prejudicially the action of the furnace.

Having received from Mr. T. E. Forster and others evidence of very good ventilation produced by the steam-jet, your committee are of opinion, that under some circumstances, more particularly where the coal to be excavated lies near the surface, it may be applied with advantage.

Your committee cannot fail to observe, that the controversy which has been going on respecting the merits of the furnace and steam-jet systems has had very beneficial results, and has produced an emulation, which has been the means of improving ventilation in many districts, and of developing the merits and the power of each system to an extent not before known.

Your committee had also evidence laid before them of the economy and power of a machine invented by Mr. Struvé, which has been materially improved since it was brought to the notice of the committee of the House of Lords in 1849. They are favorably impressed with the value of this invention, especially in

shallow pits and level collieries; but would suggest that, in consequence of the liability to derangement of all such mechanical means, a duplicate apparatus should always be kept in reserve, and ready for operation.

Your committee think that it is not desirable to enforce any particular system, but recommend that no colliery should be without some artificial means of ventilation, and that power should be given by the Legislature to enforce this recommendation.

Having investigated the different modes of producing a current of air, your committee had to consider how best to distribute it through every part of the colliery. They find that passing it in one stream through a mine is attended with such resistance, even where the air-ways are capacious, that it is impossible, where the galleries are long and the mine extensive, to obtain a sufficient quantity; and that, even if that were not the case, the air travelling from one department to another becomes charged with gas, as well as with the breath of the workmen, and other effluvia, before it has nearly finished its course, and is rendered so impure as to be detrimental to the health of those who have the disadvantage to be at the far end of its channel, while, in the case of fiery mines, it becomes dangerously charged with gas.

In the districts of Northumberland and Durham this has been long known, and the system of dividing the currents, which is technically called splitting the air, has been adopted, by which a greater quantity is obtained by the same amount of ventilating power, and each department receives its quota of fresh air, which is passed directly from it to the upcast shaft; but your committee regret to say that this is entirely neglected in many of the coal districts, in consequence of which, and of no artificial means of produding ventilation being resorted to, the health of the workmen is much impaired, and great danger incurred.

Your committee are of opinion that special care ought to be taken to make and maintain the main air-ways of sufficient capacity and number. They are sorry to observe, however, that in many districts this is not attended to. In some, the air-ways are made so small that it is difficult for a man to pass through them; the consequence is that they are seldom visited, and that, either from falls of the roof or sides, the passages originally of too little area, are nearly choked up, and the ventilation almost suspended. For this reason, without specifying size more minutely, they are of opinion that the air passages of a mine should always be so made and maintained as to allow the person in charge of them to pass through without difficulty.

It appears certain that, after explosion, two thirds of the deaths are occasioned by after-damp. Your committee have received evidences of the best means of preventing so great a sacrifice of human life. They have inquired into the merits of the plan of refuge stalls, suggested by Mr. Gurney to the committee of 1852,

and have come to the conclusion, that unless they could be maintained in great numbers, and at very short distances from the departments where the men are at work, and could, by some mode, be supplied with fresh air, they would not answer the purpose intended. Your committee prefer to place reliance on dispensing, as far as possible, with the use of doors, on having the stoppings and crossings made so solid that the force of the blast cannot disturb them, and thus cut off the air from the departments, and on some rapid means of restoring ventilation by steam-jet or otherwise, and thus overcome the stagnation consequent on an explosion. They beg particularly to direct attention to Mr. Nicholas Wood's evidence, who states that in one of his mines he has made all the stoppings and crossings so strong that the most powerful blast would not effect them. The opinions as to the necessity of clearing goaves of the foul air are so contradictory, that your committee are unable to discover any preponderance of evidence on that subject; but they are of opinion that to make bore-holes from the surface would, in many cases, be impracticable, and, even when practicable, would not be attended with satisfactory results.

The accidents which occur from falls of the roof and sides of mines, led your committee to inquire minutely what means could be suggested for their prevention. Undoubtedly an efficient system of supervision, with the abundant use of props, is highly necessary. But by long-wall working, which in some districts has been extensively used, and is gradually making its way into all parts of the country, the risk of this class of accidents appears to be materially decreased; and not only in this respect do they consider this mode as compared with the pillar-and-stall system to be the best, but the evidence leads them also to the conclusion, that for facility of conveying the air through a mine, and for obtaining the greatest quantity of coal, the long-wall system, where it can be adopted, is preferable to any other.

The deaths that take place in and about the shaft are almost entirely to be attributed either to the defective machinery or to want of care. At the conclusion of this report will be found some rules, which, if enforced, will materially diminish the number of those accidents.

Your committee have received various opinions on the security of the Davy lamp, the majority of which are in its favor. They have also had detailed to them the results of experiments conducted by Messrs. Wood and Elliott, to test the powers of resisting explosion of all the lamps which up to that time had been invented; and although they consider these experiments would have been more satisfactory had the boxes in which they were made been larger, so that the explosive atmosphere might not have acquired motion, yet they deem them a better test than those made by Dr. Bachhoffner at the Polytechnic Institution

before the committee of 1852; the first-mentioned experiments having been made with the actual gas of a mine, and those of Dr. Bachhoffner with common street gas, which according to his own evidence, is far more easily exploded than fire-damp.

Weighing carefully all the circumstances connected with this branch of the inquiry, your committee are of opinion, that safety-lamps, however valuable, should not be relied upon for the prevention of explosions. That the ventilation of mines should be kept so good, that under ordinary circumstances it would be safe to work with naked lights. That in fiery mines, especially those that are liable to sudden outbursts of gas, safety-lamps add largely to the security from explosion, and can be used without much, if any, extra cost over the naked light.

The dreadful catastrophe which occurred at Ince Hall during the course of this inquiry, induced the Secretary of State to call for the opinions of the Government inspectors as to whether gunpowder should be permitted to be used in fiery mines. Those reports were transmitted for the consideration of your committee. They have also received much contradictory evidence on this subject. On the whole, they are of opinion that, although the utmost care is necessary, it would not be advisable to pass any law for prohibiting its use.

Although they entirely agree with the committee of 1852, that the number of inspectors is decidedly too small, your committee have pleasure in being able to say that, considering the large number of collieries that have necessarily been allotted to each inspector, they have given general satisfaction; that the effect of their appointment has been beneficially felt, and their recommendations have, with few exceptions, been concurred in and carried out by the owners of mines.

The inspectors represent that their salaries are too small, stating that in consequence they have been obliged, by way of increasing their emoluments, to attend to references and other private business. This practice ought, in the opinion of your committee, to be put an end to, the whole of their time be devoted to their several districts, and their salaries sufficiently large to recompense persons of practical and scientific acquirements for filling the appointment.

Your committee think it would not be advisable to add to the power of the inspectors, but would prefer to rely on the increased responsibility which is thrown on the owner of a mine who either neglects or refuses to carry out the suggestion of an inspector, and to having the names of those parties who neglect their duty brought prominently before the public by the publication of the inspector's report.

With these views your committee recommend—that the number of inspectors be increased; that their salaries be augmented; that under no circumstances should they be allowed to attend to

any business but that connected with their public duties as inspectors of mines; that no new inspector be appointed who has not had at least seven years' experience as the practical manager of a mine; that as soon as practicable, every person before his appointment as an inspector be subjected to an examination in all the branches of science connected with mining; that reports of the inspectors be laid periodically before Parliament.

It was stated to your committee by the witnesses who represented the working men, that they desired the establishment of sub-inspectors of mines taken from the class which now supplies the overmen and other subordinate officers in the collieries, believing that men of such a class would be physically more competent than inspectors to laborious examinations of the workings; and that the miners would resort to them with more freedom to state their complaints and suspicions. Your committee have not approved of this suggestion, considering that the increased staff of inspectors, which they have recommended, will accomplish the objects of the miners, it being plainly the duty of inspectors to encourage and protect every honest statement of apprehended danger for the interests of the employers as well as of the workmen. Their interests, indeed, in all that regards the safety of the mine is identical, and your committee hope that the conviction of this truth, and the growth of a good understanding between the workmen and their employers, will render year by year the intervention of the inspectors less necessary. As their warrant for this hope, they refer with satisfaction to the impartial and intelligent views of the representatives of the working men, as stated in the minutes of the general conference, and in the evidence before your committee.

Against the system of employing contractors under the name of "butties," which prevails extensively in South Staffordshire, and partially in other districts, your committee cannot speak too strongly. It will be found by the returns upon the table of the House, that in those districts the accidents are more numerous than in others where greater danger is to be apprehended. These "butties" have no object in view but to diminish, by every means in their power, the cost of production. The ventilation, as well as the safety of the men in other respects, is neglected, and the responsibility is apparently shifted from the chief owners of the mine to these men, who, in point of education, are not superior to the workmen themselves.

Some complaints were made by witnesses as to the defective or injurious operation of existing laws, which it may be right to notice; although as the alleged grievance must affect many other classes as well as the mining class, it does not belong peculiarly to this committee to suggest the remedy.

These complaints were as to the unsatisfactory constitution and working of the coroners' courts, the difficulty of enfor-

ing compensation to survivors in case of death by negligence, under what is called "Lord Campbell's Act," and the unwillingness of magistrates to convict in cases of misconduct in service by the workmen.

It was stated, as to the coroners' courts, that the jurors summoned were generally workmen, or small tradesmen dependent on the collieries, without instruction, and open to the suspicion of partiality. This is sometimes the case, and seems to be the result of the ancient law directing coroners to summon the inhabitants of the district where death occurred, rather to be questioned as to their knowledge of the facts, than to be themselves judges of the evidence. At the present day the coroner, or rather the constable, takes the jurors from the neighborhood, without reference to qualification. Considering that the questions before an inquest, particularly in cases were death is supposed to have occurred from neglect or unskilfulness, require careful investigation, it is desirable that the law should be altered, so as to insure the requisite amount of knowledge in the jury.

The next objection was raised by some witnesses who erroneously conceived that there were greater facilities in Scotland for the representatives of the persons killed by accident recovering compensation under Lord Campbell's Act (9 and 10 Vic., cap. 93), at the instance of a public officer, than in England. This, however, is an error; it is only in criminal charges, not in any matters of damage, that the public officer in Scotland interferes; and the cases in England, where the representatives of a person killed in service by the neglect of others have failed of success, have not failed from any defect in the law, or lack of parties to put it in motion, but because the judges have held "that a servant, on his hiring, undertakes, as between him and his master, to run all the ordinary risks of the service, including the risk of negligence on the part of a fellow-servant," presuming always "that the master has taken reasonable care to preserve him from such risk, by associating him with persons of ordinary skill and care." (Vol. 5, Exchequer Reports, p. 343.)

The last complaint was, as to the refusal of magistrates to convict when cases had been brought before them of gross misconduct by colliers in the course of their service, such as unscrewing their lamps in explosive mines, or wantonly disturbing the ventilation. These were proceedings under the General Act 4 Geo. IV. c. 34, giving power to justices to determine complaints between masters and servants, and it may well have been, in the cases complained of, that the magistrates refused to convict, because they were dissatisfied with the proof, and not from any doubt as to their jurisdiction. One benefit to be expected from the establishment in all collieries of a code of rules, and from bringing a thorough knowledge of them personally home to every one engaged in the mine is, that any disobedience of the rules will

bear such a stamp of wilfulness, that it is to be presumed that no magistrate will hesitate in convicting the delinquents; and it might be enacted that every wilful breach of the rules should be deemed misconduct in service, within the meaning of the Act. One alteration in the act will clearly be necessary. According to the third clause, the complaints against the collier must be at the instance of the person who "has engaged him, or his steward, manager, or agent;" but, as the mischief which may ensue on his breach of the rules may bring loss of limb or life to his fellow-workmen, more grievous than any loss of the property to his employer, it is right that every one in the mine, whether master or servant, should have power to bring the offender before the magistrates, and the like power might be given to the inspector.

In prosecuting this inquiry, your committee felt that, while it was their duty to investigate every means that could be suggested for diminishing the number of violent deaths that occur in and about collieries, care should be taken to avoid undue interference with that most important branch of commercial enterprise, the coal trade.

With that view, your committee at the conclusion of last session, thought it right to suggest to the owners and viewers of collieries that a conference should take place between themselves, the Government Inspectors, and the delegates of the workmen. In consequence of that suggestion, meetings were held in London, to which too great importance cannot be attached.

The report of the proceedings was handed in by Mr. Nicholas Wood, as chairman of that meeting, and explanations were given by him to your committee. Mr. Dickinson also attended on the part of the Government Inspectors, and Mr. Swallow on that of the workmen.

To these proceedings your committee beg to call especial attention.

Having well considered and weighed them with the evidence, they have to recommend that the following rules be enforced by the Legislature:—

1. That the owners or occupiers of every colliery should frame a set of rules applicable to its particular state and circumstances, which rules should be agreed to and certified by the Government Inspector of the districts.

2. That adequate artificial means of ventilation be provided at all collieries, and that there shall be at all times a sufficient current of air through the workings to dilute and render harmless all noxious gases.

3. That every shaft or pit which is out of use, or used only as an air pit, should be securely fenced by its owner.

4. That every working and pumping pit or shaft be properly fenced when not at work.

5. That every working and pumping pit or shaft, where the natural strata are not safe, shall be securely cased or lined.

6. That every working pit or shaft where a steam-engine or other mechanical power is used shall be provided with guides or conductors, and that all cages or apparatus in which men descend and ascend shall be provided with covers of suitable strength.

7. That single link chains, except the short coupling chain at the end of a rope, shall not be used for lowering or raising persons in the pits or shafts.

8. That every working pit or shaft shall be provided with some proper means of signalling from underground to the surface, and *vice versa.*

9. That a proper indicator, to show the position of the load in the pit or shaft, shall be attached to every machine used for raising or lowering persons.

10. That every steam-boiler shall be provided with a proper steam-gauge, water-gauge, and safety-valve.

11. That after — months' notice given by the inspector to the owner or occupier of each colliery, any such owner or occupier shall be subject to a penalty of — *l.* for every day after the expiration of said — months for neglect of any of the above rules; and that a like system of penalties shall be applied to any default of the owners or occupiers under the existing Act; such penalty to be enforced on complaint to a magistrate.

12. That a clause be inserted in any Act to be passed for the purpose of punishing all persons employed in or about mines, for breach of colliery rules.

The Government Inspectors have suggested that ironstone mines be included in the Act, and made subject to the same rules and regulations as coal mines. The duty delegated to your committee being limited to the latter, they have not taken that recommendation into consideration.

The establishment of benefit societies and funds for the relief of widows and orphans of colliers has been considered by your committee: they are happy to observe that these are so generally adopted that no further special legislative powers are necessary.

Your committee having now recommended the rules and regulations which they think necessary, and which, if adopted, will, in their opinion, cause a diminution of fatal accidents, and an improvement in the physical condition of persons employed in coal mines; have only to allude to education, which, if liberally carried on, would improve their moral and intellectual condition, and gradually lead to better management and care on the part of the overlookers, and to less recklessness on the part of the workmen.

For the overlookers and officers of the mines additional means of education are beginning to be provided. In Newcastle a mining school is established, the good effects of which, it is stated, are already felt; and your committee cannot too strongly recommend the establishment of similar institutions in other districts,

at which the branches of science bearing upon mining should be taught.

Facilities would thus be afforded for imparting to the superintendents or overlookers, upon whom the daily and hourly conduct of the mines necessarily falls, an amount of scientific information which could not fail to induce greater vigilance in carrying out rules and precautions, obvious enough to scientific men, but which it is difficult, if not almost impossible, to have faithfully realized in practice by those who, however willing to do their duty, do not fully understand or appreciate the value of such rules and precautions. Your committee believe that the increased scientific information thus afforded to this class of men (the overlookers), would prove an important step towards lessening the number of accidents in coal mines, and more especially those arising from defective arrangements of ventilation; and they would urge upon Government to foster, by grants in aid, the establishment and maintenance of mining schools in the large mining districts throughout the country.

Education is also required for the children of the men. The necessity of this is felt by none more than the workmen themselves, who have stated their willingness to contribute, by authorized reductions from their wages, towards the support of teachers, if school accommodation be provided.

In conclusion, your committee have to observe, that although their report differs from that of the committee of 1852, as to the mode of carrying out various details, yet it will be seen, on comparing the two, that the conclusions arrived at by each committee are nearly identical—viz., that improved ventilation, efficient supervision, increased inspection, and the education of all parties engaged in this dangerous branch of commercial enterprise, must be relied on for the decrease of the numerous fatal accidents that occur annually in the coal mines.

Your committee cannot close this report without expressing an earnest hope that her Majesty's Ministers may be induced to take the important subject of the accidents in coal mines into their consideration as soon as possible, in order that no time may be lost in revising the law now in force, and in applying such further remedies as may appear practicable and effective.

ART. II.—DURABILITY OF RAILROAD IRON.*

THE complaints respecting the inferior quality of recently manufactured rails, naturally attributable to the attempts made by companies to reduce the price, have attracted attention both in this country and in the United States, and have led to some practical and scientific inquiries. On the first introduction of railroads, it was confidently asserted by their promoters, that the rails would last for indefinite periods, but experience soon demonstrated that railway bars were subject to lamination and disintegration, from the repeated rolling of heavy loads. Their duration, in some instances, has not exceeded two or three years; and in some of the earliest constructed lines in England, the rails have been changed twice, or even three times since their opening. Opportunities have accordingly presented themselves to the engineers on these lines, of ascertaining the actual powers of endurance of iron rails, and of calculating the amount and extent of traffic which they are capable of withstanding under the varied circumstances to which they are exposed. Where the conditions are favorable, and the bars themselves perfectly sound, it is believed that the traffic which rails of ordinary quality are capable of bearing will not fall very short of 20,000,000 tons. The rails laid down on many of our railways have not, however, carried one fourth of this traffic; and large quantities have been, in some instances, renewed which have not borne a tenth of that weight. Well recorded observations on this subject are much to be desired, and would prove of the greatest benefit, not only to railroad companies and their shareholders, but also to engineers, and even to the iron trade in general. In directing attention to the subject, we need not remind the public that this Journal is at the service of those who are enabled to furnish scientific or practical information in reference to it.

A paper has appeared in a recent number of the *Journal of the Franklin Institute*, of Pensylvania, "On the Durability of Railroad Iron," by Mr. William Truran, in which the question has been partially discussed, and some details supplied respecting the wear and tear of rails on some railways. Much of the information thus collected has from time to time appeared in the columns of this Journal, and although of value in a concentrated form, cannot be new to the scientific or practical English engineer. It is observable, however, that the paper is confined to some local lines, and does not refer to the great trunk railways of this country. They are, of course, the lines from which general deductions can be most safely derived, and in which the most perfect means exist of recording full and accurate information. Mr. Truran has drawn certain conclusions from the limited examples which he has been enabled to give, of the duration of railway rails under different

* From the London Mining Journal, No. 1027.

conditions of laying and working, and he remarks, that in every instance where, in the construction of the permanent way, solidity had not been obtained by the employment of adequate sleepers, the destruction of rails had been most rapid. The greater duration, on the other hand, may be attributed to the use of heavy rails, to the wagons and carriages having bearing springs, and to a well constructed and carefully maintained and permanent way. Favorable instances of durability have been found to arise from favorable grades, but the absence of bearing springs has been found to have a prejudicial effect on rails, and to have greatly lessened their duration. When the quality of the metal used has been inferior, and the nature of the fastening employed defective, unfavorable results might be naturally expected. It has, we are informed, been found in practice that the cost of labor and materials, in supplying and replacing unsound bars, and the ultimate expenses incidental to the entire renewal of the rails, of course irrespective of their first cost, is generally equivalent to the value of the old metal obtained. It is obvious that this investigation opens a field of curious and interesting inquiry, and our specially directing attention to it may, perhaps, lead to more perfect arrangements for the collection of future materials.

Every advance in the manufacture of rails is a matter of national importance, and we feel proud to acknowledge that Wales is taking the lead in practical improvement. The heaviest rail ever made has been manufactured at the Rhymney works, Monmouthshire—a Barlow rail, 52 feet 6 inches in length, 90 lbs. to the yard, being a total weight of 1,575 lbs. The longest rail ever made, a double-headed-rail, 60 feet long, 75 lbs. to the yard, total weight 1,500 lbs. has just been manufactured at Tredegar Works, also in Monmouthshire. It is difficult to decide which ought to bear the palm, the Rhymney rail being $\frac{1}{20}$ heavier than the Tredegar rail, and the Tredegar rail being $\frac{1}{7}$ longer than the Rhymney rail; but it must be remembered that a double-headed rail is more difficult to be manufactured than a Barlow rail. The reduction of duty on rails imported from this country into France, while illustrating the enlightened policy of the French Emperor, has given fresh impetus to the manufacture in England: and we believe this country is likely still to maintain her superiority. We cannot conclude without recording the public spirit evinced by the workmen at Tredegar, who, having finished their week's work (about 700 tons of rails), on learning that it was contemplated to make a long rail, volunteered, without remuneration, to manufacture the longest rail in the world. The rail was accordingly wrought, and heated in one of the ordinary furnaces, and, after a week's toil, was finished by the gratuitous labor of the workmen, whose independence thus sought to maintain the pre-eminence of their country.

Art. III.—MINING EXPERIENCE AND MINING RESULTS.
By Geo. Henwood, M.E.

There is scarcely a profitable mine in the two counties of Devon and Cornwall that has not passed through two or three companies' hands before becoming dividend-paying. The extreme anxiety of promoters of mining speculations to get their mines into work, too frequently leads them to under estimate the cost of machinery and necessary work to develope them, and are over sanguine as to the period for making profitable returns. Although the mine may be intrinsically good, yet a breach of either of these covenants sours the proprietary, and further call for a trifling outlay, which would accomplish all required, splits up the company, and the property is abandoned to some more fortunate speculators. A case of this sort struck me very forcibly on a recent occasion, by a visit to Wheal Jane, near Truro, which I consider one of the "Cornish miracles," having declared dividends of 4*l.* 10s. per share, without troubling the shareholders to advance one shilling to work it; the shares are at present worth 18*l.* to 20*l.* each. On coming on the ground, I was astonished to see this celebrated spot was well known to me as Wheal Falmouth, when working about 20 years ago. This mine was abandoned from the cause before mentioned. East Pool and Boscaswell Downs, which have both been rich mines, are also well known instances of this popular and profitable kind, and it would give me sincere pleasure to introduce one of a similar nature to my auditory. It is also obvious that, to drain these vast excavations, extensive machinery must be erected; in situations where water power can be made available a great saving is effected, but where this desideratum cannot be obtained steam must be resorted to. Many of these engines are of stupendous dimensions; some mines employ several of 70 or 80-in. cylinder for pumping, and at the Great Wheal Vor Tin Mine, near Helston, lately resumed, they are about to erect one of no less than 100 inches cylinder. These engines cost from 2,000*l.* to 3,000*l.* each. In addition to these, large and deep mines employ steam-power for raising the ores and refuse from the levels, and are called steam-whims. In many tin mines they stamp (that is, reduce the tin to a powder) by steam engines. The high price of coal in Cornwall and Devon renders this item of mining very costly.

Wood and iron enter largely into mine expenses, as in the stopes the miners use wood to prevent the walls from falling together; in loose, friable ground immense quantities of Norway timber is sawn into planks, and supported at short intervals by whole timbers, about 9 in. square, to keep the roofs and sides from tumbling away and obstructing the passage. At the surface entrance to the shafts, care is required to put a wooden framework of sufficient strength to prevent any accidents; this is called col-

laring the shaft. The capstan and shears with their enormous rope that must reach the bottom, and not less than 9 or 12-inch rope is strong enough, are also expensive items; these are used for lowering the pumps and heavy work into the mine. Candles and gunpowder, to say nothing of oil, tallow, hemp, &c., swell the sum. Then there are whims, dressing floors, dressing machinery, and a long list of et ceteras, before one word is said about the main-spring, labor. Yet, despite all these charges, the mines have paid, do, and will pay, if managed scientifically and economically. It is an acknowledged fact that more mines are discontinued from want of management than want of mineral, and that in too many cases has the money subscribed to work the mine been spent on the surface, instead of under it, or in the terrible abyss of the law. Jealousy and petty squabblings are also fertile sources of failure. This is not mining, and should not be laid to the fault of mining, as is too frequently the case. It may, perhaps, not be uninteresting here to mention the sums realized as profits by a few mining Companies:—

Great Wheal Vor, upwards of	£500,000 0 0
Great Crinnis	160,000 0 0
Pembroke	200,000 0 0
East Crinnis	200,000 0 0
Fowey Consols	350,000 0 0
Great St. George	68,000 0 0
Levant	108,800 0 0
Wheal Basset	122,880 0 0
Wheal Buller (second working)	87,787 0 0
Devon Great Consols	366,592 0 0
Great Consols, Cornwall	40,000 0 0
South Caradon	72,604 0 0
West Caradon	58,650 0 0
Alfred Consols	48 570 0 0
Great Wheal Alfred	200,000 0 0

It must be owned these are the prizes, but by no means all; it must also be admitted there are many blanks, but these need not be so numerous if adventurers would use common caution, and exercise that strict economy of management they would do in their own counting-houses or domestic concerns, and employ only scientific and trustworthy captains and managers.

The mines are mostly situated in the barren districts of the county, on the tops or sides of the hills, in the low swampy ravines, or on the edges of precipitous cliffs; in the latter situation they form interesting and picturesque subjects for the artist. Perhaps Botallack Mine, in St. Just, near the Land's End, is as grand and entertaining a spot as a stranger can visit; the urbanity of the captains and agents cannot be exceeded. The visitor at his entrance to the mine finds himself on the top of a precipitous cliff, more than 300 feet high, and far above the chimneys of the engine-house. At the base of this tremendous rock rolls the everlasting billows of the Atlantic, while midway are the engine-houses

and miners, forming, together with the rocks, a group at once noble and terrific. To obtain the full effect and grandeur of the scene, the visitor should descend to the lower part of the mine, near the sea shore, when the majesty of the place bursts upon him in awful sublimity. It is a scene not to be easily forgotten. This mine has been wrought under the sea for a distance of more than half a mile.

Some of the mines, particularly on the Dart and Goss Moors, where no wood is seen for miles, seem shut out from humanity, and led the surly Johnson, on his visit to the Cornish mines, to write the celebrated stanza:—

> O! Cornwall, barren, wretched spot of ground,
> Where naught but rocks and stones are to be found;
> Thy barren hills won't find thy pigmy sons with bread,
> Or wood to make 'm coffins when they 're dead.

To which the Cornish bard, with equal truth and wit, replied:—

> O! Cornwall, happy, blessed spot of ground,
> Where richest ores of every kind abound;
> Thy very hills are brass, thy rocks are tin,
> Thy wealth is not exposed without, but hid within.

It may appear strange to many, that in the midst of so much mineral the discovery of copper there is of comparatively modern date, tin having been the sole object of the explorers; this metal was, undoubtedly, wrought for long antecedent to the existence of copper being known. Some German miners from the Hartz are said to have been the discoverers of this invaluable deposit. It had been neglected and thrown away by the Cornish old men, a term applied to the tinners whose works are left without a history, and are to be found scattered over every part of the metalliferous districts. Hedges have been destroyed, and even roads taken up, that had been built and laid with stones containing copper ore.

It will be still more astonishing that in this century metallurgy was so neglected that abundance of silver ore had been raised and thrown away as worthless. The discoveries in California and Australia seem likely to make us more atttentive to our home resources, where we have plenty of scope, without seeking such distant shores for investment of capital. From the improved methods of smelting lately introduced, and the increased demand for black jack, blende, and the ores of zinc, which 10 or 12 years ago were worth nothing, are now become valuable; and mundic, or iron pyrites, that was considered worthless, is found to contain metals that will repay working for it. The establishment by Government of a Museum of Economic Geology in London has tended greatly to forward this science, and given it an impulse that cannot fail to be attended with important results to this country. Already Cornwall is moving in the matter, and endeavoring

to establish a branch in that county in connection with a School of Mines, where miners may receive a course of education that may teach them the value of their practical experience and discoveries, and enable them to transmit such valuable acquisitions to posterity.

As accumulated knowledge never breaks a man's back, though it gives him great weight in society, I hope the effort may be attended with success, though I own "Shadows, clouds, and darkness hang upon it;" and that the experience of the present and future captains may be superior to that of a late Cornish celebrity (Joe Odgers), who, when asked the result of his long experience as to the productiveness of lodes in certain situations, replied —"I've worked 40 years as barrow boy, tutwork man, and tributer; and my experience is this here—'Where there's ore, there's ore; and where there's none, there's none.'"

In conclusion, allow me to say a few words for the miners, whose exertions effect these mighty works. The miner's life is one of danger, toil, and hard labor. Few, very few, live to an old age, as a visit to one of the churchyards plainly indicates. Severe labor in a humid atmosphere tells its tale, even on the most robust constitution. Many fall premature victims from accidents and carelessness. They are subject to a complaint peculiar to them, called the miner's consumption, which takes off immense numbers at an early age.

ART. IV.—ON THE MANUFACTURE OF STEEL.*

A PAPER on the manufacture of steel, as carried on in different countries, was read on Wednesday evening, May 9, at the Society of Arts, by Mr. Charles Sanderson. After alluding to the antiquity of the manufacture, the composition of steel, and the raw materials from which it is prepared, the author proceeds as follows:

The kinds of steel which are manufactured are natural steel, called raw steel, or German steel; Paal steel, produced in Styria, by a peculiar method; cemented, or converted steel; cast steel, obtained by melting cemented steel; puddled steel, obtained by puddling pig iron in a peculiar way.

Natural, or German steel, is so called because it is produced direct from pig iron, the result of the fusion of the spathose iron ores alone, or in a small degree mixed with the brown oxide;

* From the London Mechanics' Mag., May, 1855.

these ores produce a highly crystalline metal, called *spiegel eisen*, that is, looking-glass iron, on account of the very large crystals the metal presents. This crude iron contains about four per cent. of carbon, and four to five per cent. of manganese. Karsten, Hassenfratz, Marcher, and Reamur, all advocate the use of gray pig iron for the production of steel; indeed, they state distinctly that first quality steel *cannot* be produced without it; that the object is to clear away all foreign matter by working it in the furnace, to retain the carbon, and to combine it with the iron. This theory I hold to be incorrect, although supported by such high authorities. Gray iron contains the maximum quantity of carbon, and, consequently, remains for a longer time in a state of fluidity than iron containing less carbon; the metal is then mixed up, not only with the foreign matter it may itself contain, but also with that with which it may become mixed in the furnace in which it is worked. This prolonged working, which is necessary to bring highly carbonized iron into a malleable state, increases the tendency to produce silicates of iron, which entering into composition with the steel during its production, renders it red short. Again, by the lengthened process, the metal becomes very tender and open in its grain; the molecules of silicate of iron which are produced will not unite with the true metallic part; and also, whenever the molecular construction of iron or steel is destroyed by excessive heat, it becomes unmalleable. Both these are the causes of red shortness, and also of the want of strength when cold. For these reasons I consider that gray pig iron is by no means the best for producing natural steel; and for the same reasons I should not recommend the highly carbonized white iron, although it is now used both in Germany and in France. In Austria, however, they have improved upon the general continental process; their pig iron is often highly carbonized, but they tap the metal from the blast furnace into a round hole, and throwing a little water on the surface, they thus chill a small cake about half an inch; this is taken from the surface, and the same operation is performed until the whole is formed into cakes; these cakes are then piled edgewise in a furnace, are covered with charcoal, and heated for 48 hours; by this process the *carbon* is very much discharged. By using these cakes in the refining, the steel is sooner made, and is of better quality. In the opinions I have given to many German steel makers, and in the advice I have offered them, I have endeavored to show that pig iron can only be freed from its impurities whilst in a fluid state. I take the advantage of the property of cast iron, and previous to melting it in the steel refinery I submit it to a purification, by which process I seek to *reduce* the degree of carbonization of the metal, and to separate and dissolve the earthy matter with which it may be combined; I then obtain a purer metal for the production of steel. The metal itself being to some extent decarbonized, is

sooner brought into "nature," as it is termed, that is, it sooner becomes steel. The process being shorter, and the metal itself being purer, there is less chance or opportunity for the formation of deleterious compounds, which, becoming incorporated with the steel, seriously injure its quality. Of course, steel manufactured from crude iron, either purified or not, of any defined quality, will inherit such quality, be it good or bad. Art can, in some degree, remove these noxious qualities from the crude iron. Chemistry has lent its powerful assistance, yet nature will maintain her sway, and in all cases the good or bad qualities of the metal will be transmitted to the steel.

The furnaces in which raw or natural steel is manufactured are nearly the same, as far as regards their general construction, in all countries where such steel is produced; yet each country, or even district, has the fire in which the metal is worked differently constructed. We find, therefore, the German, the Styrian, the Corinthian, and many other methods, all producing steel from pig iron, yet pursuing different modes of operation. These differences arise from the nature of the pig the country produces, and the peculiar habits of the workmen. These modified processes do not affect the theory of the manufacture, but they rather accommodate themselves to the peculiar character of the metal produced in the vicinity. In Siegen they use the white carbonized, manganesian metal, while in Austria a gray or mottled pig iron is used.

The furnace is built in the same form as a common charcoal refinery. There are two tuyeres, but only one tuyere iron which receives both the blast nozzles, which are so laid and directed that the currents of air cross each other, as shown by the dotted lines; the blast is kept as regular as possible, so that the fire may be of one uniform heat, whatever intensity may be required. A bottom of charcoal is rammed down very close and hard. On this is another bottom, but not so closely beaten down; this bed of charcoal protects the under one, and serves also to give out carbon to the loop of steel during its production. On this is a thin stratum of metal, which is kept in the fire to surround the loop. When the fire is hot, the first operation is to melt down a portion of pig iron, say 50 to 70 pounds, according as the pig contains more or less carbon; the charcoal is then pushed back from the upper part of the fire, and the blast, which is then reduced, is allowed to play upon the surface of the metal, adding from time to time some hammer slack, or rich cinder, the result of the previous loop. All these operations tend to *decarbonize* the metal to a certain extent; the mass begins to thicken, and at length becomes solid. The workman then draws together the charcoal and melts down another portion of metal upon the cake. This operation renders the face of the cake again fluid, but the operation of decarbonization being repeated in the second charge, it

also thickens, incorporates itself with the previous cake, and the whole becomes hard; metal is again added until the loop is completed. During these successive operations the loop is never raised before the blast, as it is in making iron, but it is drawn from the fire and hammered into a large bloom, which is cut into several pieces, the ends being kept separated from the middle or more solid parts, which are the best.

This operation, apparently so simple in itself, requires both skill and care. The workman has to judge, as the operation proceeds, of the amount of carbon which he has retained from the pig iron; if too much, the result is very raw, crude, untreatable steel; if too little, he obtains only a steelified iron. He has also to keep the cinder at a proper degree of fluidity, which is modified from time to time by the addition of quartz, old slags, &c. It is usual to keep from two to three inches of cinder on the face of the metal, to protect it from the direct action of the blast. The fire itself is formed of iron plates, and the two charcoal bottoms rise to within nine inches of the tuyere, which is laid flatter than when iron is being made. The position of the tuyere causes the fire to work more slowly, but it insures a better result.

The quantity of blast required is about 180 cubic feet per minute, at a pressure of 17 inches water gauge. Good workmen make 7 cwt. of steel in 17 hours. The waste of the pig iron is from 20 to 25 per cent., and the quantity of charcoal consumed is 240 bushels per ton. The inclination of the tuyere is 12 to 15 degrees. The flame of the fire is the best guide for the workmen. During its working it should be a red bluish color. When it becomes white the fire is working too hot.

From this description of the process, it will be evident that pig iron will require a much longer time to decarbonize than the cakes of metal which have been roasted, as already described; and, again, it must be evident that a *purified* and *decarbonized* metal, such as I have proposed, must be the best to secure a good and equal quality to the steel, since the purified metal is more homogeneous than the crude iron.

When, therefore, care has been taken in melting down each portion of metal, and a complete and a perfect layer of steel has been obtained after each successive melting, when the cinder has had due attention, so that it has been neither too thick nor too thin, and the heat of the fire regulated and modified during the progressive stages of the process, then a good result is obtained; a fine-grained steel is produced, which draws under the hammer and hardens well. However good it may be, it possesses one great defect; it is this. During its manufacture, *iron* is produced along with the steel, and becomes so intimately mixed up with it, that it injures the otherwise good qualities of the steel; the iron becomes, as it were, interlaced throughout the mass, and thus destroys its hardening quality. When any tool or instrument is

made from natural steel, without it has been very well defined, it will not receive a *permanent* cutting edge; the iron part of the mass, of course, not being hard, the tool cuts only upon the steel portion; the edge very soon, therefore, becomes destroyed. There is another defect in natural steel, but it is of less importance. When too much carbon has been left, the steel is raw and coarse, and it draws very imperfectly under the hammer; the articles manufactured from such steel often break in hardening; thus it is evident, that in producing the steel, every care, skill, and attention are required at the hands of the workman. These defects very materially affect the commercial value of the steel; the irregular quality secures no guarantee to the consumer that the tools shall be perfect, and, consequently, it is not used for the most important purposes; yet, where the raw steel is refined, it becomes a very useful metal, and is largely used in Westphalia for the manufacture of hardware, scythes, and even swords. It possesses a peculiarity of retaining its steel quality after repeated heating, arising from its carbon being, as it were, incorporated with *each* molecule of the mass. This property renders it very useful for mining and many other purposes.

The raw steel, being so imperfect, is not considered so much an article of commerce with the manufacturer, but it is sold to the steel refiners, who submit it to a process of welding. The raw steel bloom is drawn into bars, one or two inches wide and half an inch thick, or less; a number of these are put together, and welded; these bars are then thrown into water, and they are broken in smaller pieces to examine the fracture; those bars which are equally steelified, are mixed together. In manufacturing refined steel, the degree of hardness is selected to suit the kind of article which it is intended to make. A bar, two to three feet long, forms the top and bottom of the bundle, but the inside of the packet is filled with the small pieces of selected steel. This packet is then placed in a hollow fire, and carefully covered from time to time with pounded clay, to form a coat over the metal, and preserve it from the oxidizing influence of the blast. When it is at a full welding heat, it is placed under a hammer, and made as sound and homogeneous as possible; it is again cut, doubled together, and again welded. For very fine articles, the refining is increased by several doublings, but this is not carried at present to so great an extent as formerly, since cast steel is substituted, being in many cases cheaper.

I take the manufacture of puddled steel as next in order, because the product is similar to that of natural steel, that being obtained direct from the crude pig iron. It is a steel of a very recent invention, and its manufacture is carried on entirely in Westphalia. But a few years ago a very small quantity of this steel was produced from *one* work. There are now several large establishments for its manufacture. The produce is becoming considerable, and likely to increase on account of its cheapness.

The object of the operation is similar to that adopted in the making of raw steel, to decarbonize pig iron down to that point at which it can be treated as steel. The process is this:—About 280lbs. of pig iron are charged into a puddling furnace. As soon as the metal begins to melt, the damper is partly closed, and 12 to 16 shovelfulls of cinder, &c., as it comes from the hammer and rolls, are thrown into the furnace; the whole is then melted down together, and the mass is puddled with great care. The metal having become so far decarbonized as to lose its liquidity, the damper is opened, and 40lbs. of pig iron are charged near the fire-bridge of the furnace. This is allowed gradually to melt and mix itself with the metal previously charged, which causes it to boil; a blue flame rises from the surface of the mass, and very shortly the metal stiffens. The damper is again three quarters shut, and the mass is worked until it becomes waxy. The metal is then collected into balls and hammered into blooms. This steel is very imperfect; too much depends upon the manipulation of the process; it is out of the sight of the workmen, and equally from under his control, being continually covered with cinder. Practice has, no doubt, assisted materially in the improvements made in the manufacture of this steel since its introduction, but it is evident that steel produced by such a process can only be serviceable for the commonest purposes, being subject to many serious imperfections. The blooms resulting from the process described are drawn, doubled, and welded precisely in the same manner as charcoal raw steel is refined; yet, such is the acknowledged inferiority of this steel, that whilst charcoal natural steel sells for £18 per ton, the puddled steel will not command more than £14 per ton, and an equal reduction is made on the refined steel manufactured from puddled steel blooms.

The next process is the Paal method, so called, from the name of the works at which the plan is used. The works belong to Prince Schwartzenberg, and are situated near to Murrau, in Styria. The process is based upon the old one of Vanaccio; it consists in plunging iron into a bath of melted metal. The carbon of the metal combines with the iron, and in a very short time converts it into steel. This process was carried further by Vanaccio, who contrived to add wrought iron to the metal until he had decarbonized it sufficiently; this was found to produce a steel, but unfit for general use. That produced by plunging iron into metal, was found to be very hard steel on the outside, but iron within; while that produced by adding iron to the metal was found too brittle to be drawn. The Paal method, however, as I saw it used at these works, is a decided improvement in the manufacture of refined natural steel. They produce natural steel at the Prince's various works, and bring it to Paal to be refined. The packets, as already described in the refinement of natural steel, are welded and drawn to a bar; whilst hot they are plunged into

a bath of metal for a few minutes, by which the iron contained in the raw steel becomes carbonized, and thus a more regular steel is obtained than that produced by the common process. The operation requires great care, for if the bars of steel be left in the metal too long, they are more or less destroyed, or perhaps entirely melted. It commands a little higher price in the market, and is chiefly consumed by the home manufacturers, excepting a portion which is exported to Russia.

I have now described the manufacture of steel by various processes, in all of which the carbon is derived from the metal itself, and in which the whole of the molecules of the metal may be said to be equally charged; they contain the necessary amount of carbon, or steelifying principle, within themselves, and to this may be attributed the reason why, after repeated heating and hammering, the steel never loses its property of hardening. On this account, natural steel is used almost exclusively by the Mexican and South American miners for their tools.

I shall now turn to the second mode of producing steel, by introducing carbon into iron to such an extent as may be needful for the various purposes to which it is to be applied.

In explaining the theory and practice of manufacturing natural steel, I have shown that the object is to prevent the mass from becoming iron, the process being arrested at that point where the metal has lost so much of its carbon that the *remainder* is necessary for it to possess as a steel.

The process of converting iron into steel by cementation is the reverse of the process already described. The iron to be converted is placed in a furnace stratified with carbonaceous matter, and on heat being applied, the iron absorbs the carbon, and a new compound is thus formed.

When this process was discovered, is not known. At a very early period charcoal was found to harden iron, and make it a sharper cutting instrument; it seems probable that, from the hardening of small objects, bars of iron were afterwards submitted to the same process. To Reamur certainly belongs the merit of first bringing the process of conversion to any degree of perfection. His work contains a vast amount of information upon the theory of cementation; and although his investigations are in many instances not borne out by the practice of the present day, yet the *first* principles laid down by him are now the guide of the converter; our furnaces are much larger than those used by Reamur, and they are built so as to produce a more uniform and economical result; they give, however, precisely the same results which he obtained in his small ones.

A converting furnace consists simply of two troughs, built of fire-brick, 12 feet long, 3 feet wide, and 3 feet deep; the fire-room is placed between them, and the whole covered by an arched vault, so that the heat may pass entirely around these troughs,

and distribute itself equally. The bar iron is placed within these troughs, stratum superstratum along with charcoal, which is broken to the size of beans. When the troughs are full, they are covered with sand or loam, which partially vitrifies and cakes together as the heat of the furnace increases, and thus, by hermetically sealing the top, the air is excluded. This furnace being charged with about 20 tons of iron, the fire is lighted, and in the course of 60 to 70 hours the iron will have become fully heated; *at this point the conversion commences.* The pores of the iron being opened by heat, the carbon is gradually absorbed by the mass of the bar, but the *carbonization* or conversion is effected, as it were, in layers. To explain the theory in the clearest manner, let me suppose a bar to be composed of a number of laminæ—the combination of the carbon with the iron is first effected on the surface, and gradually extends from one lamina to another, until the whole is carbonized. To effect this complete carbonization, the iron requires to be kept at a considerable uniform heat for a length of time. Thin bars of iron are much sooner converted than thick ones. Reamur states, in his experiments, that if a bar of iron $\frac{3}{16}$ths of an inch thick is converted in 6 hours, a bar $\frac{7}{16}$ths of an inch would require 36 hours to attain the same degree of hardness. The carbon introduces itself *successively*, the first lamina or surface of a bar combining with a portion of the carbon with which it is in contact, gives a portion of the carbon to the second lamina, at the same time taking up a fresh quantity of carbon from the charcoal; these successive combinations are continued until the whole thickness is converted; from which theory it is evident that, from the exterior to the centre, the dose of carbon becomes proportionately less. Steel so produced cannot be said to be perfect; it possesses in some degree the defect of natural steel, being more carbonized on the surface than at the centre of the bar. From this theory we perceive that steel made by cementation is different in its character from that produced directly from crude metal. In conversion the carbon is made successively to penetrate to the centre of the bar, whilst in the production of natural steel, the molecules of metal which compose the mass are *per se* charged with a certain per centage of carbon necessary for their steelification; not imbibed, but obtained by the decarbonization of the crude iron down to a point requisite to produce steel.

During the process of cementation, the introduction of the carbon disintegrates the molecules of the metal, and in the harder steel produces a distinct crystallization of a white silvery color. Wherever the iron is unsound or imperfectly manufactured, the surface of the steel becomes covered with blisters thrown up by the dilatation of the metal and introduction of carbon between those laminæ which are imperfectly melted. Reamur and others have attributed his phenomena to the presence of sulphur, vari-

ous salts, or zinc, which dilate the metal; but this is incorrect, because we find that a bar of cast steel which is homogeneous and perfectly free from internal imperfections never blisters, for although it receives the highest dose of carbon in the furnace, yet the surface is perfectly smooth. From this it is evident that the blisters are occasioned by imperfections in the iron. Iron increases, both in length and weight, during conversion. Hard iron increases *less* than soft. The augmentation in weight may be said to be $\frac{1}{300}$, and in length $\frac{1}{120}$ on an average.

The operation of conversion is extremely simple in its manipulation; nevertheless, it requires great care, and a long as well as a varied experience to enable a manager to produce every kind or temper required by consumers. Considerable knowledge is required to ascertain the nature of the irons to be converted, because all irons do not convert equally well under the same circumstances; some require a different treatment from others, and, again, one iron may require to be converted at a different degree of heat from another. The furnace must have continual care, and be kept air-tight so that the steel, when carbonized, may not again become oxidized. Generally speaking, in working converting furnaces, but little attention is paid to the theory of producing steel, which I have endeavored to explain. It is known amongst steel-makers, that if iron be brought in contact with carbon, and if heat be applied, it will become steel. This is the knowledge gleaned up by workmen, and, I may add, by too many owners of converting furnaces. The inconvenience arising from a want of care and knowledge of the peculiar state of the iron *during* its conversion, sometimes occasions great disappointment and loss. The success usually attained by workmen may, however, be attributable to an every-day attention to one object, thus gaining their knowledge from experience alone; good, I admit, in a workman, but this should not satisfy the principal or manager of a steel works. It is, perhaps, not needful that he should be a man of science, but I consider it the duty, as it certainly is the interest, of every owner of such works, not only to satisfy himself, but to be able to convince the minds of others, that he is fully conversant with the cause and effect of every operation in his business, and although a knowledge of chemistry may throw much light upon his operation, it is also necessary that he should possess a varied experience in conjunction with it, before he can pretend to produce steel of such superior and uniform quality as the arts require. The conversion or carbonization of the iron, is the foundation of steel making, and, as such, may be considered as the first step in its manufacture. Before bar steel is used for manufacturing purposes it has to be heated, and hammered or rolled. Its principal uses are for files, agricultural implements, spades, shovels, wire, &c., and in very large quantities for coach springs.

Bar steel is also used for manufacturing shear steel. It is heated, drawn to lengths 3 feet long, then subjected to a welding heat, and some six or eight bars are welded together precisely as described in the refinement of natural steel; this is called single shear. It is further refined by doubling the bar, and submitting it to a second welding and hammering; the result is a clearer and more homogeneous steel. During the last seven years the manufacture of this steel has been limited, mechanics preferring a soft steel, which is much superior when properly manufactured, and which can be very easily welded to iron.

The price of bar steel varies according to the price of the iron from which it is made, but, as a general average, its price in commerce may be taken at £5 per ton beyond the price of iron from which it is made. Bar steel produced from the better irons is usually dearer than the commoner kind, on account of their scarcity.

Shear steel in ordinary size sells at £60 per ton nett.

Coach spring steel from foreign iron, £22 per ton nett.

Coach spring steel from English iron £18 per ton nett.

These may be taken as approximate prices in 1854-5.

From the outline which I have given of the processes by which various steels are manufactured, it will be seen that there are in each great defects, want of uniformity, temper, or clearness of surface, unfitting them for many useful purposes. To obviate these defects, both bar converted and also raw steel are *melted*, by which the metal is freed from any deleterious matter which the iron might have contained; a uniform and homogeneous texture is obtained, whilst an equality in temper or degree of hardness is secured; besides which, the surface is capable of receiving a high, clear, and beautiful polish—qualities which the other steels I have described do not possess. The first steel which may be called cast steel is the celebrated wootz or India; it is produced by mixing rich iron ore with charcoal in small cups or crucibles. These are placed in a furnace, and a high heat is given by a blast. After a certain time this ore melts and receives a dose of carbon from the leaves and charcoal charged with it. The result is a small lump of metal with a radiated surface about the size of a small apple cut in two: it is very difficult to work; nevertheless, swords and other steel implements are manufactured from it in the East; it is found in England as an article of commerce. The melting of bar steel was first practically carried out by Mr. Huntsman, of Attercliffe, near Sheffield, whose son yet carries on its manufacture, for which he enjoys a very high celebrity, by making use of the best materials, and insisting upon the most careful manipulation of his steel in every process. The manufacture of cast steel is in itself a very simple process. Bar steel is broken into small pieces, which are put into a crucible, and are melted in a furnace about 18 inches square and 3 feet deep. The crucible is placed on a stand 3 inches thick,

which is placed on the grate bars of the furnace. Coke is used as fuel, and an intense heat is obtained, by having a chimney about 40 feet high. Although a very intense white heat is obtained, yet it requires 3½ hours to perfectly melt 30 lbs. of bar steel. When the steel is completely fluid, the crucible is drawn from the furnace, and the steel is poured into a cast iron mould. The result is an ingot of steel, which is subsequently heated and hammered, or rolled, according to the want of the manufacturers. Although I stated that the melting of cast steel is a simple process, yet, on the other hand, the manufacture of cast steel suitable for the *various wants* of those who consume it requires an extensive knowledge; a person who is capable of successfully conducting a manufactory, must make himself master of the treatment to which the steel in manufactures will be submitted by every person who consumes it. Cast steel is not only made of many degrees of hardness, but it is also made of different qualities; a steel maker has, therefore, to combine a very intimate knowledge of the exact intrinsic quality of the iron he uses, or that produced by a mixture of two or three kinds together; he has to secure as complete and as equal a degree of carbonization as possible, which can only be attained by possessing a perfect practical and theoretical knowledge of the process of converting; he has to know that the steel he uses is equal in hardness, in which, without much practice, he may easily be deceived; he must give his own instruction for its being carefully melted, and he must examine its fracture by breaking off the end of each ingot, and exercise his judgment whether or not proper care has been taken; besides all this knowledge and care, a steel maker has to adapt the *capabilities* of his steel to the *wants* and *requirements* of the consumers. There are a vast variety of defects in steel as usually manufactured; but there are a far greater number of instances in which steel is *not adapted* for the manufacture of the article for which it was expressly made. Cast steel may be manufactured for planing, boring, or turning tools; its defects may be, that the tools when made crack in the process of hardening, or that the tool whilst exceedingly strong in one part, will be found in another part utterly useless.

Art. V.—Some Remarks on the Metalliferous Veins of the South.—By Oscar M. Lieber, Assistant Geologist to the State of Alabama.

It is deeply to be regretted, that in our country so little attention has been paid to what might be termed the comparative anatomy of veins—a careful investigation and comparison of the various

characteristics of veins and groups of veins, a subject in which Professor Cotta, of Freiberg, has made himself so justly celebrated. The practical importance of these observations will alone render them worthy of prosecution. American mining is, however, in so incipient a stage of development, that it is but natural that these matters should as yet receive little attention. Still, when we perceive such clever articles, as one in this Magazine, on the "Mining in Wall-street," pointing towards a prospective advance in mining, it may not be improper to call attention to so important a topic as vein geology. Under this impression, at least, I venture to offer a few observations on the subject, and to present the conclusions to which they appear to conduct us. It should, nevertheless, be recollected, that the writer is guided rather by the desire to excite in others a similar interest to that which he himself feels, and to assist in the development of this important branch of the geology of his portion of the country, than by the arrogant wish of seeking to propound theories, which shall be incontrovertible.

Cotta makes the true remark, that geology is a science, based upon facts solely, and that theories can be admissible only so long as they explain the facts observed. The moment that these disagree with the theories, the latter must be abandoned. This we must always recollect, and likewise should we remember, that the simplest explanation will ever possess an advantage over the more elaborate hypotheses.

The immediate topic upon which it is proposed to dwell somewhat in these remarks, refers to a certain class of metalliferous veins in the South, and my object is to point out its leading features.

At the time when I first entered upon the duties assigned me in the geological survey of Alabama (in the fall of 1854), the copper excitement was at its greatest height. Peculiarities of the surface rocks and minerals, which presented some similarity with those in the neighborhood of the mines of Ducktown, in Tennessee, induced an active search for copper. The singular dissemination of this metal throughout the western portion of the metamorphic rocks of Alabama, although occurring in minute quantity only, acted as a strong incentive. At the time, it occurred to me, that it would be highly probable that, if copper should really be found in available quantities, its occurrence would differ from the exceptional case of Ducktown, and that quartz true veins should be sought for. For a long time the search proved unsuccessful, and only latterly has it been my good fortune to meet with those possessing cupriferous contents. The locality to which I allude is at Dr. Ulrich's vineyard, in Tallapoosa County, some nine miles south-west of Goldville. The veins at this spot had been originally worked for gold, though without success, as the richest ore was worth only from 10 to 12 cents per bushel. Ga-

lena was also found, and this led to the belief, that argentiferous ores might appear at a greater depth. After a considerable expenditure of money, the mining operations were, however, abandoned. Lately, while blasting out a cellar at the junction of the gneiss (the chief country rock) and the talcose slate, a number of small quartzose veins were discovered, which were found to contain copper pyrites in very considerable quantity, when we reflect that a depth of only twelve to eighteen feet from the surface had been reached, and that the veins are very small. The veins north of this point are evidently dipping towards it, showing that, in all probability, the main lode will finally descend between the two distinct country rocks. Malachite and other minerals, resulting from the decomposition of the pyritiferous copper ores, are almost entirely wanting, a fact which proves that the copper never extended much above its present level in the veins.

At an old gold pit, about four miles north-east of this place, a considerable amount of galena was found, disseminated in minute particles throughout the quartzose gangue. The mine was abandoned, on account of the lode entering a more solid country, and the gold diminishing in quantity. Copper was not found, that I am aware of. This may have been owing to the fact, that a sufficient depth was not attained.

Basing the conclusions upon the theory of Professor Cotta, that the contents of a large and important class of metalliferous lodes were derived from solutions, which reached the materials from igneous rocks beneath—(see the translation of his article in the October, November and December numbers of 1854 of this Magazine)—there is strong inducement to believe that these veins belong to an extensive group, which we find also in South and North Carolina. It is, probably, also discernible in Georgia, but there I have had no means of collecting evidence.

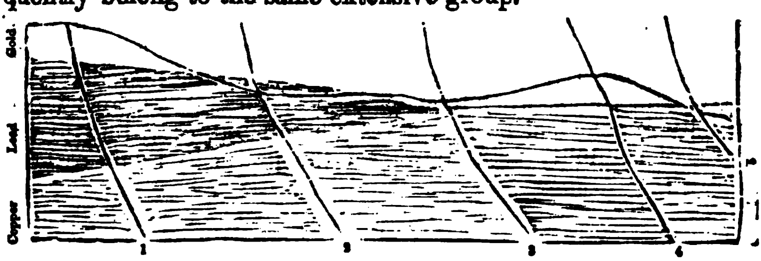
In South Carolina we have an instance in an old gold mine, in Chesterfield district, where galena and copper pyrites occur. At the time of my visit, the mine was in a very deplorable state of abandonment, and the works being all under water, the observations could extend only to surface evidences, and the examination of the heaps of ore and attle.

Another vein of this description is seen at the Morgan mine, in Spartenburg district, South Carolina, which has been described by Mr. Manross. In the Charleston *Mercury*, of the 6th February, 1855, an extract from his report is given, in which we read that the contents are, besides phosphate and carbonate of lead, galena, and lower in the vein, copper pyrites. Mr. Manross observes, that "the only change which can be perceived in the metallic contents of the vein in descending, is the greater abundance of copper ore." This alteration in the character of the contents was observable, although a depth of eighteen feet only had been attained.

It is impossible to mention all the veins of this class in North

Carolina, where, if not more numerous than elsewhere, at least more of the kind have been opened. Among them, we find the auriferous and cupriferous lode of the McCulloch mine, where, however, I have not heard that any galena or other plumbiferous ores have been met with, and the Vanderburg mine, which I examined with some care, in the course of last year (1854). The vein has not yet attained any very great size, but its geological features are of the utmost interest. It has been worked for gold, but, at a depth of from fifty to sixty feet, copper first presents itself, chiefly in the shape of the green and blue carbonates. Only when we descend to twenty or thirty feet below this point, do we meet with the undecomposed sulphurets of this metal, of which a variety are found. Galena, in small quantity only, has been discovered here, in conjunction with the copper.

In carrying out our investigations on this subject, we shall frequently have occasion to regret that in our country all mines are of such comparatively recent origin, and that, as yet, the depth attained in no instance admits of the correct and satisfactory establishment of a definite knowledge concerning the true and final character of metalliferous lodes. If European men of science can lament this fact with their mines, how much more occasion have we to deplore an ignorance on the subject! Confining our suppositions, therefore, to the little only with which we are definitely acquainted, we would come to the conclusion that we have an extensive group of veins in the Southern States, which present a very similar character in all cases belonging to that class, although local differences may be perceptible. There are certainly, also, other vein groups in the South widely differing in their characteristics from that before us. The features possessed by this group seem to be found chiefly in the disposal of the contents, of which gold appears uppermost, or nearest to the surface, lead central, and copper lowest, as far as we have been able to extend our experience. In few instances only do we meet with the whole complete succession; in some the lead may be wanting, and the copper follow immediately upon the gold, while in others the auriferous portion of the lode may have been removed by abrasion and decomposition. In the accompanying diagram, it has been my object to endeavor to offer an explanation of the local varieties which may present themselves, but which, with all their differences, only strengthen the belief in the similar general character of the veins, and in the probability that they consequently belong to the same extensive group.



In this cut the black line indicates the outline of the surface, and shows the veins to be cut off above, at various levels.

In vein No. 1 we have an instance, in which the whole series of the metals is developed.

In No. 2 no gold is found, but the thickness of the lead is still considerable.

In No. 3 we find all the metals again, though but little gold and lead.

In No. 4 the gold rests immediately upon the copper, without any lead occurring between.

In No. 5 all portions of the vein, down to the copper, have been removed.

In so far as this suggestion appears to convey a full explanation of the various cases before us, it may not be unworthy of attention.

It might be asserted, as an argument against this theory, that we frequently find copper and lead ores amid the auriferous portion of the veins, and gold associated with galena and copper pyrites. A second thought will, however, scarcely admit this as a refutation. In the diagram, the object has been to explain grand effects, and not to deal with trivial matters, which refer only to hand specimens, and exert no power upon the main character of the lodes. Even as local and unimportant occurrences, indeed, nothing can be adduced from these, which can offer an objection to the theory, even if we except the translocation of metallic bodies, by galvanic action, since the filling up of the lodes.

Let us take for granted, then, for the moment, that really the series of metals is that exhibited in the cut. We suppose them, according to Professor Cotta's theory, to have been deposited not only in harmony with laws which govern their various degrees of solubility, but in accordance with the changing contents of the solutions, owing to the fact that they may have been supplied from different or changing sources, and the varying temperature of the upper portions of the country, as well as the general difference of this from that of the solutions. Here already we find a full explanation of the local differences of the position of minerals, which really seem remarkably exceptional. The mother liquid, whose duty it was to fill the crevices in the country rock, may, for instance, after depositing lead and copper, have received a fresh supply of gold, and hence the gold in the ores of the former, or, after copper had been precipitated, lead may have been introduced into the solution, and consequently we find galena among the sulphurets of copper. Nor is it unreasonable to suppose that a liquid which, at a high temperature, and subjected to immense pressure, could hold in suspension all the ingredients of a lode, and which, when one or both of these conditions were partially removed, deposited a certain mineral, according to its degree of solubility—still possessed the power to retain certain

smaller quantities of the same substance, which were thrown down at a subsequent period, when the attending circumstances had rendered the solvent unable to exert its former powers. The intense heat and powerful pressure which were required to produce these results, are unfortunately beyond our power of control and reproduction, and, therefore, we can scarcely ever hope to attain satisfactory results in the laboratory. Still we must believe that, if future developments prove this theory to be correct, those portions of the country rocks which are connected with the parts of the lodes now known to us, must, at the date of the precipitation of the contents of the vein, have possessed a temperature approximating to that of the solution. In this we find an explanation of the apparent horizontal distribution of the contents of the veins. This is, however, only the case on a grand scale; for, as usual, so also here, do we perceive signs of an irregularly vertical position having been adopted by the individual constituents of every portion of the vein, and the minerals all assume their respective positions with regard to the axis and selvages of the lode.

The gangue rock of this group is a ferruginous quartz, usually of a yellow or pink color. In some parts it is very porous, or rather cellular in its structure, owing to the decomposition of various pyrites. The upper portion is frequently friable; lower down it is more compact. The auriferous portion commonly contains hydrated peroxide of iron, derived from the decomposition of iron pyrites, and often retaining the crystalline form of the latter. In the cupriferous portion chiefly do we find spathose minerals and arsenical pyrites, and undecomposed iron pyrites abound here also.

The strike seems almost always to be N.E., but at various angles. The Vanderburg lode, however, strikes N.W. The dip is usually to the S.E., and very steep. The Vanderburg is an exception, and dips S.W. Their linear extent on the surface is, of course, very variable, as is also their thickness.

The country rocks in which we find these veins, differ widely from one another. Thus Mr. Manross states that at the Morgan mine to be a micaceous slate, while at the Vanderburg it is dioritic slate, and at Dr. Ulrich's, chiefly gneiss. This fact is comparatively unimportant, for the vein crevices appear to have been formed subsequent to the deposition and consolidation of all the metamorphic rocks of the region; and though it is reasonable to suppose that one rock should be markedly less ruptured than another—for the varying degrees of hardness must have exerted some influence upon the force necessary for severing them, and, consequently, the veins will be either decreased or increased in number, or will expand or contract accordingly—still, this would have no effect upon the character of the contents, nor afford an objection to the veins in the various rocks being grouped together.

In offering this solution to the problem he has given himself, the writer feels considerable diffidence, since he possesses, after all, a knowledge of but very few cases. Attention, however, being thus called to the matter, others may, perhaps, feel themselves induced to take up the gauntlet, and prosecute these researches with greater effect. Among the number who might have done much to develope this portion of the geology of our country, we must deeply regret Mr. Ellory, whose energetic examination of the interesting mines of North Carolina was the cause of his early death.

Practical men in our country are much inclined to undervalue scientific research; yet, in this instance, it is to be hoped that they, too, will perceive the importance of a thorough investigation, for, if future observations prove these remarks to be correct, we should be possessed of no bad guide in the determination of the final character of those veins, which belong to this group, and, as usual, science would lend a helping hand to practical operations.

Art. VI.—HISTORY OF THE ENGLISH IRON TRADE SINCE 1830.*

At the close of the previous article, the subject of boiling pig iron was under consideration.

From the time of drawing a heat, it is ten or fifteen minutes before the puddler is again able to charge. Six heats of $3\frac{1}{2}$ cwt. may be worked in the twelve hours.

There is also a difference in wages.

Say for puddling refined metal . . .	8s.	per ton.
" boiling pig	10s.	"

The yield also is in favor of the refined metal, not only in the puddling, but likewise in the after process of heating and rolling.

On the subject of boiling pig-iron, our author thus remarks:—

Boiling pig-iron, although not so advantageous to the ironmaster, is nevertheless generally done where they have not the convenience of refineries; it was adopted with the idea of its being a cheaper mode of working, in saving coals, labor and yield; but this is met by the extra quantity of coals used in the puddling, bearing on a smaller make, besides which the wages are higher, and there is a greater waste in the more expensive process. Also, a greater expense is incurred in keeping the furnace in order, as the pig iron works hotter than the refined metal, and injures the bottom as well as the walls of the furnace.

In South Wales the boiling process has been very generally done away with, as it is not found to suit the general nature of the iron. The Staffordshire and Shropshire iron is, however, well suited for boiling, being of a strong-bodied nature, and there this method of working is still used to some extent,

* Continued from page 240, Vol. V.

but more frequently where they have not refineries. Where, however, the iron is of a red, short nature, a small quantity of gray pig is very beneficial, and materially assists the quality as well as the appearance of the iron.

With the view of saving the time which is lost in heating the iron to the state in which it becomes fit for the puddler to commence his operations, there have been various contrivances for heating the fresh charge of metal, whilst the preceding heat is in progress. One plan is, to make the flue rather wider, so as to form a sort of recess for the reception of the fresh charge, which is placed there by the puddler's assistant through a small door for the purpose; and when his heat is finished, is drawn forward, and is ready for him to go on with, without any delay. The simplest method, however, is to make the body of the furnace longer than according to the old plan, and to have a second door, between where the puddler works and the stack. This affords sufficient convenience and room for the succeeding charge of metal.

With these furnaces nine heats can readily be worked by one man in twelve hours: and if, as is sometimes the case, the furnace is provided with three sets of men, instead of two, ten or even twelve heats may be finished in the twelve hours.

Economy of coal is the object of the ironmaster in this mode of working; and as the quantity used is nearly the same, whether the furnace be constructed on the old or new plan, there is a considerable saving. The men, however, generally prefer the usual mode of working, and make about seven heats in the twelve hours, a quantity which they seldom exceed. The weekly average of a puddling-furnace being from 12½ to 18 tons.

The next improvement was the substitution of the hot blast. This was introduced by a Mr. Neilson, of Glasgow. With the nature and importance of this improvement, our readers are doubtless familiar. We will, however, introduce, as not entirely out of place, some remarks on the effects of this improvement, made at a public dinner in Pottsville, Penn., in 1840. Some may, perhaps, remember the occasion.

On the 18th of January, 1840, a dinner was given at Pottsville, Pennsylvania, by W. Lyman, Esq., on the occasion of his having successfully introduced the smelting of iron with anthracite by the use of hot blast. Mr. Nicholas Biddle, who attended to witness the result of the experiments, after expressing his entire satisfaction in their success, observes,—"And this, after all, is the great mystery—the substitution of what is called the hot blast for the cold blast. Let us see the changes which this simple discovery is destined to make. As long as the iron ores and the coal of the anthracite region were incapable of fusion, the ores were entirely useless, and the coal nearly unavailable for manufactures, while, as the disappearance of the timber made charcoal very expensive, the iron of Eastern Pennsylvania was comparatively small in quantity and high in price, and the defective communications with the interior made its transportation very costly. The result was, that with all the materials of supplying iron in our own hands, the country has been obliged to pay enormous sums to Europeans for this necessary. In two years alone—1836–7, the importations of iron and steel amounted to upwards of twenty-four millions of dollars. The importations for the last five years have been about forty-nine millions of dollars. It is especially mortifying to see, that even in Pennsylvania, there has been introduced within the last seven years, exclusive of hardware and cutlery, nearly 80,000 tons of iron, and that of these there were about 49,000 tons of railroad iron, costing probably three millions and a half of dollars. Nay, this very day, in visiting your mines, we saw at the farthest depths of these subterranean passages, that the very coal and iron were brought to the mouth of the mines on rail tracks of British iron, manufactured in Britain, and sent to us from a distance of 3,000 miles. This dependence is deplorable. It ought to cease for ever; and let us hope that with

the new power this day acquired, we shall rescue ourselves hereafter from such a costly humiliation. We owe it to ourselves, not thus to throw away the bounties of Providence, which in these very materials has blessed us with a profusion wholly unknown elsewhere. The United States contain, according to the best estimates, not less than 80,000 square miles of coal, which is about sixteen times as much as the coal-measures of all Europe. A single one of these gigantic masses runs about 900 miles from Pennsylvania to Alabama, and must itself embrace 50,000 square miles, equal to the whole surface of England Proper. Confining ourselves to Pennsylvania alone, out of fifty-four counties of the State, no less than thirty have coal and iron in them. Out of the 44,000 square miles which form the area of Pennsylvania, there are 10,000 miles of coal and iron, while all Great Britain and Ireland have only 2,000; so that Pennsylvania has five times as much coal and iron as the country to which we annually pay eight or ten millions of dollars for iron. Again, the anthracite coal-fields of Pennsylvania are six or eight times as large as those of South Wales. Of these great masses it may be said confidently, that the coal and the iron are at least as rich in quality and as abundant in quantity as those of Great Britain, with this most material distinction in their favor, that they lie above the water level, and are easily accessible, while many of the mines of England are a thousand or fifteen hundred feet below the surface. With these resources you would have abundant employment, if you could only supply the present wants of the country, for which we are now dependent on foreigners. But the sphere of demand is every day widening for the consumption of iron. The time has come when nothing but iron roads will satisfy the impatience of travellers and the competitions of trade. The time is approaching when iron ships will supplant these heavy, short-lived, and inflammable structures of wood. We shall not long be content to cover our houses with strips of wood under the name of shingles, prepared for the first spark, if we can have low-priced iron, in which event, too, the present pavements of our towns would be superseded by footways of iron. The only difficulty which is suggested, is the high price of labor in this country. Allow me to say that I consider this a misapprehension. The high rate of wages is always put forward as the obstacle to any effort to make for ourselves what we import, but I do not believe that it ever made any serious obstacle in practice. I believe, on the contrary, that in any comparison between the price of labor in England and the United States, if we consider not the nominal price paid the laborer, but the amount of work actually done for a given sum of money, and if we regard the English poor-rates, which are only a disguised addition to the rate of wages, we shall arrive at the conclusion that labor is very little, if at all higher in the United States than in England.

"If coal and iron have made Great Britain what she is, if this has given her the power of 400,000,000 of men, and impelled the manufactories which have made us, like the rest of the world, her debtors, why should not we, with at least equal advantages, make them the instruments of our own independence."

The commercial history of the English iron trade is a part of this subject, of much interest, especially during the period in which it has gained its present magnitude. To this view we shall now return.

Fourteen years ago we stated, says our author, that iron being altogether the production of our own soil, will continue to give employment to hundreds of thousands of our population, *to the great advantage of the country at large, as well, we trust, as the individual benefit of the ironmaster.* What vast changes have taken place since that time! The iron trade then holding a position of great national importance, has now increased to double the then

annual make. From 1,300,000 tons to 2,700,000 tons! There can be little difficulty in showing, to the *present* advantage of the country, but more so in proving it to have been to the advantage of the manufacturer. That the trade has been greatly productive to many of the original ironmasters, there can be little doubt; amongst others, Sir John Guest, Mr. Alderman Thompson, and last, though not least, Mr. James Foster, who possessed possibly a more perfect knowledge of his trade than any other ironmaster. These gentlemen have died, leaving large fortunes, and some of the survivors are merchant princes. The reverse of the picture points to the Messrs. Hartford, of the Ebbw Vale and Sirhowy Works, whose lamentable failure was most deeply deplored; and whether the books of the ironmasters in general would admit of the same searching investigation as that to which the books of the Joint Stock Companies are yearly or more frequently subjected, is a matter which may admit of some doubt, when the events of the period are taken into consideration. As regards ironmasters in general we say, as we said before, that we trust it is to their benefit—there are no means of showing to the contrary—the country benefits by their exertions. But we have a test as regards Joint Stock Companies. Thirty years' experience proves that, according to all that has hitherto been done, they are not—but we will not say cannot—be profitable.

In the management of these companies every necessary ingredient seems to be collected to lead to a beneficial result. You have as Directors some of the first and most able of the London merchants; Bankers, most able financiers; Mining talent, the best that can be procured. You have occasionally the assistance of the original proprietors of the works, which have been either leased or purchased, and although these gentlemen may by their neighbors have been called peddling managers, yet the very narrowness of their views may, for the sake of the argument, be considered beneficial in checking the reputed lavish expenditure of Joint Stock Companies; and thus, instead of by active measures bringing matters to a speedy close, they may, on the homœopathic principle, prolong existence by administering small globules.

Of what are called the managers of the works, it will be hardly necessary to speak; good salaries are offered as an inducement to parties to tender their services, and the best selection is supposed to be made. But these persons hold but a very secondary position; the management rests with others, who, under the name of local boards, visiting directors, or inspectors (physicians they have been called), by their interference take it into their own hands, and the only undivided share which the so-called manager retains, is the responsibility.

To make the picture complete, you have for the general management possibly the best arrangement which could be adopted—that of Managing Directors, consisting of two or three able and

intelligent men of business, whose knowledge of the trade, and great anxiety to show a successful result, tend to assimilate the company to a private trading firm.

And these gentlemen have under their superintendence what may be supposed to be a choice of works, which, with their original large capital, they were enabled to command. But *cui bono?* You have the solemn farce, year after year, of a general meeting of the proprietors; with rarely an exception, a report is read to explain the various unforeseen circumstances which have occurred to militate against the expected success of the year's transactions, so as to render it impossible or inexpedient to make a dividend; a reduction in the establishment is suggested; thanks are given to the acting directors, which they well deserve for their anxious endeavors to make the best of an almost hopeless case, and the meeting separates, leaving the proprietors *to hope against hope* for another year.

The managment of Joint Stock Iron Companies in foreign countries may not be carried out on the same able principles as in this country; at any rate, they do not seem more successful. A writer in the "London Mining Journal," of the 27th Aug., 1842, who had just visited Belgium, thus speaks of the ironworks: "There are 58 blast furnaces in that country. Four-fifths of them belong to Joint Stock Companies, and not one of which, we regret to learn, is at present paying dividends to the shareholders."

Whence does this arise? It has been shown that the management in itself contains all that is necessary to a successful result: the companies are, in the first instance, possessed of large capitals, and nothing could be more legitimate than their original institution at a time when the trade was a perfect monopoly; and so formidable did they appear, that an eminent ironmaster now living, in a letter which the writer saw, expressed a wish that the companies, like the heads of the Hydra, had but one body, and that he could at once put his foot upon them and crush them to death. How many of those who rushed into these companies would have been thankful in after years, if he had had the power of carrying his wish into effect! We again say whence does this want of success arise? Are Joint Stock Companies incompatible with success in ironmaking? On the contrary, with such arrangements as we have described, they ought to be most successful, provided that the management had the proper and sufficient means of carrying their exertions into effect. These means we consider to be *concentration* and sufficient *ready-money capital.* Without these, or at any rate the latter, no talent, no exertion, will alter the dire results of the last thirty years' experience!

When companies are first formed, the greater part of the capital is paid away, either for works already erected, or else in bringing a new mineral field into operation, and by the time the works are erected and a sufficient supply of materials on the banks,

the capital is pretty well exhausted; the ready sale of the iron being considered capable of yielding profit for dividend, maintaining a stock of materials, keeping the works in repair, and leaving a sufficient balance at the bankers for monthly requirements.

With respect to the first point, *concentration*, having acquired a valuable property, the advantages are manifest; you have but one establishment, and the whole weight is thrown on this one work to bring it to perfection; it stands on its own merits; it has not to carry, besides its own burden, a lame brother; the successful work cannot be marred by the unsuccessful.

But the still more important ingredient of success is money. It is not sufficient to the success of a company that it should barely have the means of carrying on the works from month to month; a sudden check comes; there is a want of demand, the bankers are resorted to; then comes a pressure on the money market, and to pay off the extra assistance, you are compelled to sell large quantities of iron at a ruinously low price; and to whom is it sold? Why, to the ready-money proprietors of other iron-works, who, in return, will undersell you with your own iron. This is no fanciful picture. If proprietors in Joint Stock Iron-works really require success, give the sinews to the management, and do not, year after year, hope against hope, while the property itself is wearing out; the country may be benefited, but not so the shareholders. The iron trade is not like our other staples; it is not reproductive. In cotton, the seed is sown, and you have yearly crops; in wool, the sheep are yearly shorn, and you still keep up your stock; but iron, once taken out of the ground, leaves nothing behind to restore the value of the property; and if a yearly sum be not laid by, you have at the termination of your lease or minerals, nothing but valueless furnaces, and land utterly useless for any purpose; the capital will be annihilated, and "like the baseless fabric of a vision, leave not a rack behind."

To aid a successful result, an ironmaster must occasionally be an iron-purchaser; with ready money this can be accomplished. Then a depression in the trade is the period *to sow the seed of profit*—instead of sellers become purchasers of iron which cannot be made for the money, and store it till the improvement takes place, when you not only reap the direct and large profit, but you are also able to meet the certain and immediate demand for an advance of wages, which affects in every way the manufacture of iron. It falls upon the coal, ironstone, limestone, and labor generally, which, with the needy ironmaster, sweeps away all the profit possibly of months, making, in fact, an advance in price a positive loss. In many—we may say in most—cases upon an advance the ironmaster has to supply hundreds or thousands of tons at a low price, but made with the advanced wages, all of which might be readily met to the great advantage of the iron companies, pro-

vided they possessed a sufficient capital; without it dividends can hardly be expected, because there will seldom be available profits.

We cannot leave this part of the subject without alluding to the Scotch iron trade. Has the extraordinary working of the Airdrie mineral field been of individual or even general advantage?

The make of iron in Scotland in 1830 was 37,500 tons; soon after this time the important discovery of the hot blast and other improvements, aided by the black-band ironstone, increased the make so considerably that in 1839 it amounted to 196,960 tons; and in 1842 it was 276,250 tons. A writer of the day says, "The increased make in Scotland and reduction in price are, doubtless, attributable to the discovery of the 'black band' and the application of the 'hot blast,' while unfortunately these twofold advantages have been the cause of the present state of the trade, and the depression of price—affecting, as such does, not only the ironmaster, but the collier, and furnacemen—without, as we contend, a correspondent advantage being derived by the consumer."

The Times of the 5th Dec. 1842, in a leading article refers the evil of this great increase to the Scotch system of banking. The writer observes :—

"It is much to be desired, as a preparation for that effort which must certainly be made in the next session of Parliament to put down that system of banking in Scotland which places the traders of England at a disadvantage, and embarrasses the circulation of the whole kingdom, that those who have access to practical information on the subject would give it freely to the public. There is no time to be lost, if it is wished to make the proper impression on the public and the Legislature, previously to February next, and a few facts which only merchants and observant men of business can furnish, are worth numberless arguments in such a case. The following remarks, though they relate to only one branch of our native industry, the iron trade, are very much to the purpose, and will be generally acceptable :—

"'The injustice of permitting a paper circulation in Scotland while it is prohibited in England, is so palpable, that it is matter of surprise the great body of English manufacturers, upon whom this paper system has inflicted such extensive injury, should not long since have taken up the question, with the view of being placed upon equal terms in the race of intense competition with which they are visited from Scotland. In confirmation of your views of the injury done to the English dealer by the facilities afforded by the paper issues of Scotland, I will take, by way of example, one interest only—that of the iron trade, which it is well known has been long suffering from great depression.

"'Fourteen years ago the whole of Scotland scarcely produced 35,000 tons of iron per annum, the greater portion of which be-

ing absorbed at home, its influence on the English market was unknown. Last year Scotland, stimulated and encouraged by the large advances and paper issues of her banks, produced an enormous quantity of iron, with which she has deluged every part of England without the least regard to the important fact, that the demand all the time was decreasing in the same ratio that their supply increased; and what is the result? Prices have been forced down, even in Scotland, below the cost of production, the workmen, in the mean time, being ground to the earth to enable the masters there to continue their insane conflict with each other as to who shall produce the greatest quantity, and sell it at the lowest price! This ruinous system of over-trading has reacted with fearful severity upon the mining interests of Staffordshire and South Wales, and hence the outbreak in the month of August last, which was to be attributed entirely to the pressure upon those districts from the excessive production of the Scotch works, which has placed the English ironmasters in this position —that having to pay their workmen in hard money, while their competitors in Scotland are paying in paper, they were undersold in the market, and had no alternative but to stop their works altogether, or to reduce wages to a point which threw their men into almost open rebellion. This, be assured, is the true solution of the riots in the mining districts of August last; for whatever may be said to the contrary, neither Chartists nor corn-law agitators would have been listened to for a moment, had not distress (mainly to be traced to the immense production in Scotland) made the workmen ripe for disturbance.

"'Sir Robert Peel is the only statesman living who can successfully grapple with this giant monopoly of the paper money in Scotland, and to him the commercial interest in England look for redress. If a paper circulation is good for Scotland, it is good for England, and there can be no valid reason why one portion of the kingdom should be favored at the expense of the other. Common justice demands that both countries should enjoy equal privileges, and that the question of the currency should be placed on such a basis as not to give unfair advantage to any particular district or class of the community.'"

The railway mania of 1844 and 1845 gave a great stimulus to the iron trade, and the Scotch ironmasters greatly increased their make.

	Tons.		Tons.
In 1845 the shipments in the Clyde were	284,101,	leaving a stock of	250,000
1846 " "	376,951	"	145,000

The shipments continued at about the same rate till 1851,

	Tons.		Tons.
when they amounted to . . .	. 452,756,	leaving a stock of	. 850,000
In 1852 the shipments were	. 424,020,	" .	. 450,000
" 1853 " "	. 619,920,	" .	. 220,000

The make had gradually increased to about 800,000 tons, which may be taken as the average of the years 1851 and 1852; in 1853, it was 700,000 tons. With the increase of make and prospect of demand, there sprang up a system of what was called *speculation*, and the prices were thereby supported; hundreds of thousands of tons of iron were sold by passing a slip of paper from hand to hand. This went on till the bubble burst, and many of the unfortunate holders of these scrip receipts were ruined. Speculation still gives a fictitious value to the iron, but the transactions are now based on warrants, the iron being actually in safe deposit, and available when required; but as far as legitimate trade is concerned, it has been but a sorry business, and foreigners principally have reaped the benefit of this reckless production.

		s.	d.	
The average price in 1848 was	. . .	44	5	per ton,
"	1849 . . .	46	1	"
"	1850 . . .	44	5	"
"	1851 . . .	40	3	"
"	1852 . . .	45	4	"
	and in 1853 it was pushed up to .	61	4	"

An extensive dealer in Glasgow thus describes the operations of the market. In his annual circular of the 31st Dec. 1851, he says, "Our pig-iron-market opened on the 1st Jan. at 45*s.* a slow but gradual decline took place, and continued till the end of August, when it reached 38*s.* 3*d.* *Speculation buyers* then came in, whose operations drove prices up to 40*s.*; a downward course was then resumed until the end of November, when some buying took place in anticipation of a demand for spring shipments, and it rose to 40*s.*" He then alludes to the banking system:—"The unsound system so long pursued by our moneyed interest, and so much deprecated, of giving undue facilities to weak jobbers, has of late been severely censured and discouraged; and it is to be hoped that its discontinuance will give rise to a much healthier and more legitimate state of the trade, than has existed for some time past."

In 1852, "The pig-iron market opened in January *at 37s. and it gradually gave way till the beginning of February, when it touched* 35*s.* 6*d.* An impression that such low and unremunerating price would not long continue, then became pretty general; but the supply still far exceeding the demand, no confidence was felt in the trade until the end of April, when upon several furnaces being put out of blast, the dealers bought freely to stock, and prices resumed an upward tendency, *reaching* 40*s.* *towards the middle of June.* Speculation then sent prices up to 45*s.*, and on the 30th Dec. under strong speculative influence, the price was driven up to 77*s.* 6*d.*, but in the course of two days it fell to 70*s.* under the pressure of forced sales. The stock increased this year 100,000 tons. There were 113 furnaces in blast at the end of the year, and fifteen additional furnaces coming into operation."

(To be continued.)

COMMERCIAL ASPECT OF THE MINING INTEREST.

New York, September 24th, 1855.

There is no excitement in the market for mining stocks. A dead calm seems to prevail. Yet though values of mining stocks are depressed generally, there is considerable pertinacity displayed in working the various coal, copper, gold, and other mines that have been opened within the last few years. With all the financial troubles experienced, there has been more honest miscalculation than systematic fraud. This last quality has been displayed in Wall St. mostly in coal, and other mining companies. The only two mining companies whose stocks have been active during the month, have been Reading and Cumberland coal. In these there have been large transactions, and small fluctuations in price. Reading stock is well maintained. It has advanced considerably during the current year, owing to the increased receipts, though those of August show a slight abatement from the August receipts of 1854. The previous increase was, however, too great to allow of any serious depreciation of the value of the stock which has receded from the highest point of the year, that it attained in the middle of August. Some large transactions in the stock of Cumberland coal have appeared, but the price shows great steadiness. The decline has not been above half of one per cent. for the month. Pennsylvania coal, and Delaware Hudson Canal stocks are quiet at their usual high prices. No speculative evils appear, while confidence in their present values is at the highest.

There has been some appreciation in the value and rates of money, since our last review, which has been calculated to depreciate slightly the exchangeable value of all securities put on the market, and this of course extends to mining stocks, checking whatever disposition there was previously to increased animation. Money is now currently worth for its use, on loan and discount, seven per cent., and when risk, or length of time is added, higher rates are obtained. The supply, however, is good and ample for all borrowers offering standard securities, and the prospects are, that though there may be a greater activity of demand from a revival of business at this season, the greater on account of the plentiful harvest, the supply will be large enough to prevent any stringency. The general prosperity which must ultimately ensue from our rich harvest, will bring about a revival of mining adventure in its train, and we have only to say to those engaged in mining adventures:—Bide your time. A good time is coming.

The copper mines of the Lake Superior district continue to yield abundantly. Very great productiveness attaches to the Minnesota Rockland and Cliff mines, while other newer mines are approximating to the prosperity which marks their established ones. Isle Royal is one of the most promising.

The Norwich mining company, of Ontonagon, Lake Superior, has just published a report of its condition. This company is now independent of the American Mining Company, from which the property has been purchased by a new organization, the President of which is now Mr. Asa H. Center of this city. The mine has yielded this season 175 tons, and is expected before the

close to yield altogether 200 tons. The company have paid off, since the 1st of April, $44,000 out of its $85,000 indebtedness, thus reduced to $41,000.

The assessment of one dollar per share, payable on the first instant, was to furnish the winter supplies, which, the directors having got the means, are now engaged in doing. The time of payment was anticipated by many stockholders, viz., on 11,967 shares. Recent accounts from the mine represent it as constantly improving and as promising well. More copper, says the report, is now in sight than there ever has yet been. Another assessment will probably be required next spring, as next year's product, however large, will not be realized till the fall months.

The Windsor Mining Company, of Ontonagon, Lake Superior, have also made a report. This Company has been organized, with Mr. Nathaniel Hayden of New York as president, and has an office 65 Wall street. The company has reduced its indebtedness from $38,226 51cts. on the 1st of April, to only $6,996 06cts. on the 30th of August. The expenses of the company will be large this season for purposes not immediately connected with producing copper. A railroad is being constructed from the kiln-house to the stamp house. Another assessment of one per cent. is required, which the directors hope will be the last. The machinery and supplies wanted will cost about $44,000, while the proceeding copper sales will be only $12,000, requiring $32,000 to be raised; but of this, only $20,000 is wanted immediately. The one per cent. assessment is to be paid on the 1st of October, and in the spring another is likely to be wanted.

JOURNAL OF MINING LAWS AND REGULATIONS.

THE RIGHTS OF MINERS IN CALIFORNIA.

It is a matter with difficulty realized, that so large and powerful a fraction of the community, as ninety-nine hundredths, should have their rights jeopardized, and their highest interests endangered, by the remaining one hundredth; but, when we view the condition of things in our midst, in their true light, this must unhesitatingly be pronounced the case.

Not long since, it is well known to this community, an action was brought by J. T. McClintock, (the owner of a ranch, comprising a portion of the rich diggings of Pike Flat,) against Messrs. Bryden and others, for mining on that locality.

The case came up in the District Court of the 10th judicial district, Wm. T. Barbour presiding, and it was ruled, as we understand, that a ranch of one hundred and sixty acres under enclosure, could be held by the agriculturist for whatever purpose he might desire to use the same, whether for mining, or for raising barley, wheat or vegetables—that it was his property to all intents and purposes, against any and every body, save the government of the United States.

It is impossible in so brief an article as this must needs be, and perhaps it would be presumptuous, for us to attempt a criticism as to the legality of this decision. The pith of the reasoning which leads the learned judge to this decision, is, first: That the mineral lands belong to the government of the

United States—and second: That he who is in possession of the land, has the best title, till he is dispossessed by the real owner. The Hon. Judge holds himself irresponsible for this decision, save its subservience to the law of the land. For the good, or the evil effects, that it may produce upon the social and political condition of the country, he does not hold himself accountable. He claims as his function the proper administration of the laws as they exist, and if these are unwise and mischievous, censures the legislature and not the judiciary. This feeling on his part is doubtless correct, and we would attempt no censure. Let every man do his duty, fearlessly and conscientiously, and however much we may differ from him, we will not blame. It appears to us, however, with due deference to the experience, talents, and legal erudition of the Hon. Judge, that the process of reasoning which has led to this decision is full of sophistry and error, and will involve the interests of this country, if carried out, in a fearful maelstrom of doubt, collision and ruin.

Three fourths, probably, of the mining claims in the vicinity of this place are covered by the claims of agriculturists, and, if this decision is sustained by the judiciary of California, the unfortunate condition of this country is indeed to be deprecated. A few favored landlords will own our entire country, and the prospecting miner, wherever he shall wend his way, as he goes forth in hope and determination, to test the willing earth for that which is to support his wife and children, that too, which is, and should be considered the great product of California, will be driven away, with "Get you hence, why do you dare intrude on these, my domains. Look—do you not see this land is *fenced?*"

By the treaty of Guadalupe Hidalgo, concluded and signed February 2d, 1848, the United States became the owner of all unclaimed lands and territory embraced within the limits of Upper California. The same having been sold and ceded to the United States, by its former owner, the Mexican Republic, it became subject to the action of Congress, for it has "the power to dispose of, and to make all needful rules and regulations respecting the territory or other property belonging to the United States."

By an act of Congress, approved September 9th, 1850, the State of California was admitted into the Union upon an equal footing, in all respects, with the original States. The 3d section of the act of admission, reads as follows: "And be it further enacted, that the said State of California is admitted into the Union upon the express condition that the people of said State, through their legislature or otherwise, shall never interfere with the *primary disposal* of the public lands within its limits, and shall pass no law and do no act whereby the title of the United States to, and right to dispose of, the same, shall be impaired or questioned."

The mineral lands in the State of California being a part of the territory ceded to the United States by the Mexican Republic, the ownership and title thereto is, and remains, in the United States, and her Congress has the power to dispose of, and to make all needful rules and regulations respecting the same. She can sell, dispose of, and appropriate her mineral and agricultural lands, or authorize their survey, and pre-emption, or reserve them therefrom, and from the influence of all pre-emption laws. By an act of Congress, approved March 3d, 1854, entitled, "An act to provide for the survey of the Public Lands in California, the granting of pre-emption rights therein and for other purposes," it is provided in the 3d section thereof, in reference to surveys, "that none other than *township lines*, shall be surveyed when the lands are *mineral*, or are deemed unfit for cultivation. It is also provided in the 6th section of same act: "That all the public lands in the State of California, whether svrveyed or unsurveyed, with the exception of sections 16 and 36, which shall be, and hereby are, rented to the State, for the purpose of public schools in each township, and with the exception of lands appropriated under the authority of this act or reserved by proper authority, and excepting also the lands claimed under any foreign grant or title, and the mineral lands, shall be subject to the pre-emption laws, &c." Section 12, of the same act, grants

seventy-two sections of land to the State of California, to be selected by the Governor thereof for the use of a seminary of learning," and the last and 15th section of the same act grants to the State of California ten entire sections of land for the purpose of erecting the public buildings of the State, and both of said sections contain the following proviso; "that no *mineral lands*, or lands reserved for any public service whatever, or lands to which any settler may be entitled under the provisions of this act, shall be subject to such selection."

Thus it appears that Congress has made provision for the survey and disposal of all her public lands with the exception of those known as *mineral* lands in the State of California, and has made them subject to her pre-emption laws. Her *mineral lands* are *reserved* from *survey* (except by township lines) and from *pre-emption* and *sale*. In other than the mineral portions of the State, the agriculturist, by the act of the owner, is permitted, encouraged and authorized to locate and possess a certain part and section of the public domain—this, too, by a positive law, conferring a positive right; but the same law which confers such right contains the negative proviso, that the mineral lands are reserved and set apart, and of them he is not permitted, encouraged or authorized to locate and possess any part or section.

At the time of the passage of this act (March 3d, 1853), it was well understood by the Owner of the public domain, and by the law-maker of the act, that the mineral lands of the State were being successfully developed by individual miners, and by associations, who had in accordance with custom, usages and regulations, by, and among themselves, adopted as their own common law, invested their capital and labor, in opening, working, and producing therefrom, its greatest value—its gold. The policy of the National Government always has been, and yet is, to encourage by means of pre-emption laws, the actual settlement, occupation and cultivation of her agricultural lands; but in the case of *mineral lands*, the reverse is true, and they are always reserved, and the intention of such reservation is, that such lands shall be subject to the occupation and possession of such citizens as may, and can develope their mineral resources and wealth.

If Congress has intended to *permit* license, or *encourage* the occupation and settlement of her *mineral* lands in California, for *agricultural purposes*, then those lands would not have been expressly reserved from survey, pre-emption, and disposal in the same act by which she does permit, license, &c., the occupation and settlement of her other public lands, in the same State, for agricultural purposes. If there had been no mineral (gold) in these lands, then, they would not have been reserved; but there is gold, and they have been reserved; and why? Will a sane man infer that they are thus reserved, in order that the agriculturist may thereby be the better enabled to locate and possess them in unsurveyed and undefined sections?—so that the gold mines and fields may be closed and sealed up by the location and possession of ranches for cattle grazing, or vegetable cultivation?

Over three years previous to the passage of this act, the attention of Congress was called to the consideration of the situation of the mineral lands in California, by President Fillmore, and since then, the subject has been, to some extent, canvassed in and out of our National Councils. That the citizens of California have been working and occupying the mines under the local customs, wages and regulations, has been since '49 well known to the Owner; and yet Congress, up to this time, has refused to interfere with the disposition of her mineral lands as now and heretofore made by miners.

Congress has in effect declared, "our mines are being worked—let them be worked; they shall not be pre-empted, or subject to pre-emption, they shall not be sold."

Such being the position of the mineral lands, so far as the Owner, the United States, is concerned, is it not contrary to reason, to consent to, or assert the proposition, "that a man can possess and hold a section or quarter section of mineral land for agricultural purposes in the mineral regions of the State of California, by the implied consent of the General Government? —*Grass Valley Telegraph.*

LAW OF PATENTS IN BELGIUM.

ART. 1.—Patents to be granted, of invention, improvement, and of importation, for any discovery, or improvement capable of being put in operation as an object of industry or commerce.

2.—Patents to be granted, upon the proper application being made, at the risk of the applicant, and without their validity being guaranteed in any way, and without prejudice to the just rights of third parties.

3.—Patents to be of the duration of 20 years, except in the case specified by Art 14. Patent rights to commence the day on which the application for the patent is filed. A yearly progressive duty is to be paid on each patent—viz: first year, 10 fr.; second year, 20 fr.; third year, 30 fr.; and so on, increasing 10 fr. each year. Patents for an improvement upon a former patent, when delivered to the proprietor (*titulaire*) of the principal patent, not to be subject to the above tax.

4, 5, 6, 7, 8, 9, 10, 11, 12, 13.—Patents to confer the exclusive property in the invention, and to be enforced by courts of law. Courts of law empowered to confiscate piracies for the profit of the patentee. The Court of First Instance (similar to our County Court) to authorize "experts," to inspect an alleged infringer's premises, to make an inventory of piracies, and to regulate (*pendente lite*) the custody of the same, &c. The "experts," (scientific or practical referees) to be named by the court, and sworn to faithfulness. Regulations as to further proceedings to obtain final confiscation of piracies, &c.

14.—The author of a discovery, already patented in a foreign country, may obtain in his own name, or in the name of his legalized nominee (*ayant droit*), a patent of importation in Belgium; but the duration of such Belgian patent shall not exceed that of the patent before granted in the foreign country, and in no case endures for more than years.

15, 16.—Patents for improvement of a former patent shall expire at the same time with the principal patent. If the possessor of the patent of improvement, and of the principal patent, be not the same, then the principal patentee is debarred the use of the improvement, and the other is debarred the use of the principal patent, unless both agree. Patents of improvement, as well as patents of importation and invention, to confer similar legal rights.

17, 18.—Persons desirous of obtaining a patent to deposit, on application for such patent, the specification and drawings (if any) at the proper office; but no application will be accepted till the receipt for the first year's tax is produced. A certificate of the filing of the application is delivered, which attests the legal date of the invention.

19, 20, 21.—Patents to be delivered in due course and gazetted. Specifications to be published three months after. The patentee may, if he likes, supply a full copy or abstract, in which case he will have to pay the cost of publication, transfers, &c., of patents to be registered.

22.—The non-payment of the yearly tax in advance forfeits the patent.

23.—The patentee must put the invention in operation in Belgium within a year after it is put to work in a foreign country, or, if he gets a royal license, within the second year allowed by such license. Non-compliance with this forfeits the payment.

24.—Patents will be null and void from the following causes:—viz., When the object patented is found to have been previously employed for a commercial purpose. When the patentee has given an insufficient specification. When it shall be proved that a complete description of the invention has been published before the legal date of the invention.

25, 26, 27.—The court shall annul a patent, when the object to which it relates shall have been previously patented in Belgium, or a foreign country. Nevertheless, this shall not affect a foreign inventor, or his nominee, as comprised within Article 14.

26.—Patents under the old law to remain in force, and be judged thereby; but such patents may be placed under the new law, if application to that effect be made within twelve months. Payments already made under the old aw to count as equivalent to so much annual tax, &c.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

Grass Valley is the location of the most active Quartz mining operations at present in California. The efforts to extract Gold from the Quartz rock were earliest commenced there, and have been prosecuted with the greatest vigor. The last arrivals bring some very interesting information from that region.

EXPERIENCE IN QUARTZ MINING.

An experienced and skilful writer, has commenced a review of Quartz mining in Grass Valley, which is valuable as furnishing an opportunity for comparison with similar operations elsewhere.

Attention was first drawn to this branch of mining in the fall of 1850, by the most extravagant reports of the richness of leads, which were said to have been discovered all over the State. Specimens of extraordinary richness were produced as *fair samples* of the leads. The public ear was then ripe for any speculation, however wild; and by the summer of 1851, every body appeared quartz mad. Companies were formed; some prominent and influential man chosen for president; agents were dispatched to the States and to Europe, to raise capital and purchase machinery. They were successful. Out came machinery, out came agents and attaches, composed of geologists, surveyors, engineers, mechanics and miners. Machinery was placed upon leads which had prospected at the rate of hundreds of dollars to the ton, but which would not yield sufficient to pay expenses, then by no means light. This failure to secure such returns, as had been anticipated from results of specimens, was attributed to a defect in machinery, and a cry was made for new crushing powers, and for amalgamators which would save the gold. The call was immediately answered by the production of "crushers," "triturators," and "amalgamators." There was Berdan's revolving basin, with balls; Cochran's big iron balls chasing little ones; Blaidsell's basin and balls; Cream's revolving iron cylinder; Collyer's triturator and amalgamator; and a variety of others, most of which, if not all, have been abandoned, and many are now in the hands of our founders to be cast into stamps, which had been in many instances set aside, in favor of one or the other of the above "infallible methods." Then there was the smelting process, by which the molten rock and the base metals were to flow out of one door, leaving the gold to make its exit by another. Another plan advocated was, to put the rock in a perspiration, and thus sweat out "the ore." It is not our design to underrate the importance of a liberal education, yet inasmuch as we presume that most of the inventors of these various methods were men with a knowledge of "mathematics, geology, chemistry, and the general principles of natural science," we are at a loss to account for the fact, that all the numerous methods above mentioned, should, after the large amounts expended on some of them, be set aside in favor of the stamp and batteries so long in use. There was one old fogy, who, having studied mathematics, chemistry, geology, mineralogy, &c., in Great Britain and Germany, went to Mexico; and, after years of practical experience as a miner, came to California, and had the temerity, in the face of all the infallible methods, to introduce the same system for extracting the gold from the ore, which is still used and has been used in that benighted country for two centuries. He caused to be constructed twelve arastras or tahonas, which he formed into two groups of six each, having one in the centre giving motion to the five surrounding. This gave rise to the name "Planetary System," as applied to quartz working.

As might have been anticipated, this system did not meet the requirements of that day, being much too slow. This old fogy system condemned, he retired to his closet, where he has occupied himself in pursuit of his favorite studies, ever since, until a few days back, when, upon hearing that one of the Grass Valley companies had put up an arastra, and was well satisfied with the result, he threw down his books, clapped his hands in glee, put on his specs, consulted his correspondence from Mexico, and finding that great improvements had recently been made there, in the construction of the arastra, he laid his plans before some of our prominent miners, and at once received a commision from Messrs. Raymond & Stackhouse, of the Orleans Mill, to superintend the construction of one at their works. The design is to run the tailings from the stampers into the arastra, and thus to pulverize the rock to the finest degree, and to save any gold that may have escaped over the blankets, &c. His calculations are, that one of these arastras will be sufficient to work the tailings from twenty tons of rock each twenty four hours. The power required will be small, while the expense of construction is a mere trifle. Several other mills will also have these additions. Our friend of the Planetary System is prepared to furnish working plans with full directions for the erection and management of said improved arastras. Some of our miners are already convinced that more money can be made by the thorough crushing and working of 8 or 10 tons of rock daily, than by imperfectly crushing 20 tons.

Much money was unquestionably lost in the early days of Quartz mining; indeed, we may say that failure awaited every effort. But the trial is over. With a bright future before us, it is no longer a speculation, but a legitimate business, which promises a better return with less risk than any other business in the State. We have among us the men of 1851, who, having lost one half their capital in San Francisco, came here to lose the other; but who, notwithstanding, did not lose their courage. Their perseverance is about to have its reward. The Empire company, with a *nominal* capital of five hundred thousand dollars, has just declared a dividend of one per cent. upon that amount, with the promise of another shortly. As a proof that a knowledge of "mathematics, geology, &c.," is not a prerequisite to insure success in mining, we will cite an instance, in corroboration of our assertion, where a party of some five or six miners or "workers" in placer diggings, struck a lead of quartz, which, on prospecting, proved rich. They raised several tons of rock, had it hauled to a mill, owned by a man who had not prepared himself by "a long course of study in the pursuit of scientific knowledge," and who did not possess a "large capital," but simply a mill with ten stamps, worked by water power, and which cost some few thousand dollars only. The rock was crushed at the said mill, and yielded over one hundred dollars to the ton. The quantity crushed was 80 tons. We would, if necessary, cite other cases of a similar nature, with the exception of the yield, which, in this instance, was very large.

While we freely admit that a large capital, in some instances, may be requisite, yet we assert that a capital of ten, twenty, or thirty thousand dollars, judiciously managed, may be employed quite as profitably, if not more so than a larger one.

In conclusion, we conceive that nothing more is required to insure success, than a ledge that will produce a reasonable quantity of ore, with a yield of fifteen to twenty dollars a ton; a small capital to open the ledge; a mill, to reduce the said ore, and a good share of common sense. These, with close observation, industry and prudent economy, will insure to their possessor as much gold as he ought to covet.

QUARTZ MINING IN GRASS VALLEY.

A sketch of present operations in Grass Valley, California, is commenced by the Editor of the Grass Valley Telegraph, in which mining is viewed in a sensible and truthful aspect.

A flying visit, the past week, to several of our principal Quartz Mills and mining localities, has served to strengthen, more than ever, our conviction in the prosperity and permanency of this branch of industry, in Grass Valley. Operators in Quartz, whether at the mill or in the vein, are now working with increased energy, and a more free expenditure of means than has heretofore been noticed. Several old workings that have long been abandoned, have recently been re-opened with very satisfactory results, and many new and exceedingly promising veins have been discovered within the past few weeks. A new and bright day has, in fact, dawned upon the legitimate mining interests, not only of Grass Valley, but of the entire State, and many are already rejoicing at its advent, and in the cheering prospect so clearly revealed. Capitalists who have hitherto regarded the Quartz business as a mere receptacle for the absorption of capital, are now beginning to regard it in its true light, and are casting about for opportunities of investment in this branch of industry.

The only fear is that the natural impulsiveness of our people will again lead them to extremes. This, above all other kinds of business, requires profound judgment and deliberate action. Operations, to be successful, must be carried on with the greatest care. The idea that every vein, in which a rich "pocket" is found, must be valuable, is now exploded, and the location of machinery is not now thought of, until the veins are properly opened and thoroughly prospected. Numerous companies are at this time actively pursuing this preliminary work, and laying the foundation for extensive mining operations. It will be our object, in future numbers, to note the progress and developments of such operations; as from *such* facts *alone*, can any accurate opinion be formed of the business. Occasional extraordinary yields of rock, afford no criterion by which to judge of the real value of a vein. Such information must be based upon its general characteristics, and upon the extent of the explorations which have been made. In the present number, we would briefly speak of our visit to the works of *The Rocky Bar Mining Company.*—The operations of this Company are now under the superintendence of its Mining Engineer, Mr. C. S. Seyton. The claims of the Company are located upon Massachusetts Hill, on the North bank of Wolf Creek, about one and a half miles below town.

Mr. S. commenced operations on the Hill, in December last, by sinking a shaft, which has been put down with great difficulty and much labor, to the depth of 124 feet from the surface, and eighty below the natural water level of the hill. A mining pump has been erected at the mouth of the shaft, capable of raising 260 gallons of water per minute, which is driven by an engine of thirty horse power, which is also made to raise the ore. From the bottom of this shaft, a cross level is driven to the vein, at the intersection of which, two main galleries are run along the face of the vein, in opposite directions. These galleries will be extended 250 feet each way, thus opening up a breast of work 500 feet in length, and 80 to 100 in height, measuring along the slope of the vein. The entire work of shaft, level and galleries, is of a superior order to anything of the kind we have examined in this vicinity. The Engine Shaft is a magnificent piece of work; the excavation being 11 feet by 6, and timbered strongly through its entire depth, the setts being of 8 inch square timber, and the boarding 1¼ inches.

About 60 tons of rock have already been raised, and crushed at the French mill, which yielded from $25 to $40 per ton. This must be considered a very extraordinary yield, especially when the fact is taken into consideration that a large part of the rock was taken from the main drift, below the water level —under which circumstances, the yield must be, at least, 20 per cent. less than would be obtained from the same *rock*, taken out in the ordinary process of *stopeing*.

Several hundred pounds of very rich specimens, have already been taken out. The general characteristics of the vein rock are most encouraging, and should they continue to present the same favorable appearances as heretofore,

(of which there can scarcely be a doubt), the Company will find themselves in possession of one of the most valuable leads in the county. The enclosing rock, at the present working, is a kind of decomposed greenstone, very easily mined. The works above, as well as below ground, are also of the most substantial character, and reflect much credit upon the gentleman in charge.

The pump has been kept constantly at work day and night since the 30th of April, throwing 14,000 gallons of water per hour. The entire hill and surrounding district is rapidly becoming "dried up" from the effect of this immense drainage, and miners in neighboring claims are now working at points from 40 to 60 feet lower than they have hitherto been able to reach. We shall watch with much interest, the future progress of the work in this mine.

Large Yield.—In our last issue, we gave a short account of the mining operations of "The Rocky Bar Co." on Massachusetts Hill. Since then they have had crushed at the Gold Hill Mill, another lot of 28 tons of ore, which yielded $80 to the ton. Nine bushels of rich Specimens were culled from this lot. This yield more than confirms the favorable opinion we gave last week of this mine.

QUARTZ MINES OF GRASS VALLEY.

A person who has never examined with care into the extent of the quartz mining interest of Grass Valley, can form but a very imperfect idea of the importance of this branch of our industry. It is estimated from the most reliable data, that at least 150 gold-bearing quartz veins have been discovered within the precincts of this mining district. Of this number, only about 50 have been opened sufficiently to give any considerable value to them, some 25 or 30 of which, it may be safe to estimate, will continue to improve in value as they are opened up, for many years to come, and will be profitably worked long after the present generation shall have been laid in their graves. Many more of the original number of 150 will doubtless prove valuable, when the proper appliances of labor and capital are brought to bear upon them. Scarce a week passes without additional discoveries being made. Two or three new and very promising discoveries of this description are recorded elsewhere in the present issue.

Of the veins which are already classed as "paying," not more than seven or eight have even yet been wrought below the water level of the hills in which they are located—yet they have all been proven of undoubted extent and richness, sufficient to warrant the erection of extensive machinery for raising and reducing the ore. Upon three of them, effective machinery, driven by steam, has been erected for the purpose of drainage and lifting.

Many of the second class, will undoubtedly prove equally extensive and rich, when the same amount of exploration has been made upon them. The amount of rock which is now raised from the eight veins, above alluded to, is about 85 tons daily, which, however, by new openings and appliances on several of them, will be increased to about double that amount in the course of a few weeks. The average yield of the rock from these veins is about $2 per ton, consequently, when the additional improvements are completed, the gross proceeds of these same veins will not be short of $25,000 per week—about one half of which will be a net profit over and above all expenses of quarrying, crushing, interest on investment, &c. Some three or four of these veins are averaging a much higher amount than $25 to the ton—the general average being brought down by a large amount of poor rock from other veins, which in some instances has fallen as low as $12 to the ton. But as our object is to state the whole truth, we give the facts as they exist. $25 per ton is the lowest average that can be placed upon the entire amount of quartz crushed at the mills in Grass Valley, and that amount has been proven to be a good paying yield.

In addition to the yield of these eight principal veins, at least one-third more should be added as the results of the occasional workings and explora-

tions which are constantly going on in other localities, in our midst, of lesser note.

One very important feature connected with the mines in this vicinity, is that with scarcely an exception, thus far, the veins have increased both in thickness, and in richness, as they have descended.

The amount of actual cash capital invested in the business, in this place, at the present time, cannot be less than $600,000; the number of mills now in operation is eleven, capable of reducing 220 tons every twenty-four hours. The mills are all under the direction of competent and prudent managers, and supplied with every appliance for working, which past experience, in this or any other country, can suggest.

There is now connected with the business in this place, a universal feeling of permanent interest, permanent residence, and permanent prosperity. The inexhaustible nature of our resources is as firmly established as are the rock-ribbed hills, upon which our beautiful mountain home is situated.

The business of quartz mining possesses one very important advantage over every other branch of mining in California, in the fact that on every good, well defined vein, a company may locate, if they please, for life, with their families, and gather around them all the comforts and conveniences of their former homes. There is a permanency connected with it which will warrant the construction of comfortable dwellings, and which must eventually build up communities, and towns; where schools, lyceums, reading rooms, and all the advantages and opportunities which we have left in our former homes, may again be found. Such a state of society is what is most needed in California, and until resources are developed which will accomplish all this, we can never hope to have among us a happy, contented and permanent population.—*Telegraph.*

YIELD OF GOLD PER TON OF ROCK.

We seldom take the trouble to chronicle the instances of rich strikes, which are constantly occurring around us, both in Quartz and Placer mining, for the simple reason, that their publication always conveys erroneous impressions of the value of those localities where they are made. We have known instances where pounds of gold have been taken from a panful of earth, and yet the claims would not average sufficient to pay fair wages. We have also known quartz veins to yield rock that would pay fifty, sixty, and even a hundred dollars to the ton, for many tons in succession, and still the vein would not *average* rock that would pay for working. Indeed, we have now in our mind a quartz vein from which several tons of rock were raised which paid $90 to the ton. Yet, within one month from that time, the work upon it was stopped because it would not pay expenses. That very vein has now been neglected for upwards of two years.—Such leads are those where the gold seems to be collected in "pockets," leaving the great mass of the vein, almost entirely destitute of the precious mineral; or where the lead is so narrow, or in such an unfavorable position for working, that the labor of raising the rock is greatly enhanced. The value of a vein or placer mining claim can be arrived at only by a pretty correct idea of its extent, and its average yield, for a long period of working. Intelligent, practical miners are aware of these facts, and pay little, if any attention to the numerous reports of "rich strikes," which are so frequently chronicled by the press, in every part of the State. Thirty tons of rock were crushed a few days since, from the new vein recently discovered on Allison's Ranch, yielding the almost unprecedented sum of $8,000, within a fraction of $250 to the ton.

Forty dollars to the ton was taken, a few days since, from a lot of rock out of an old vein, lately re-opened on the south side of Wool Creek, directly opposite Massachusetts Hill.

Our old friends, Messrs. Judd and Laton, seem to have been born under a lucky star. They have long been considered among the most fortunate of quartz

miners in this vicinity, having each amassed a comfortable fortune at the business within the last two years. A short time since they purchased, for a small sum, a new lead, heretofore supposed to be worth but little. But no sooner had it passed into their hands than—*presto!* and the vein which had previously yielded but indifferent rock, suddenly began to improve, and they have just realized something over $1,500, from 16 tons of rock reduced by the Gold Hill Mill—$94 to the ton.

The North Carolina Copper and Gold Mining Co.—This Company has struck excellent ore on their lead, one mile south of Rough & Ready, and about three from Grass Valley, which prospects eighty dollars to the ton in gold, with a good yield of copper.—*Grass Valley Telegraph.*

American Falls Mining Co.—To those who think the mines of California, or even the rivers, which have been worked the longest, are any thing like exhausted, we would recommend the perusal of the following account of the operations of the American Falls Mining Company. The claims of this company are located on the Middle Fork of the American River, about two miles above its junction with the North Fork. At this point the bed of the river has been at some time blocked up by a large slide of rocks from the left bank of the stream, which has formed a complete dam, raising the water on the upper side 20 or 25 feet above its original level, and above its present level on the lower side of the dam. This damming up of the waters has caused an immense deposit of auriferous gravel on the upper side, which lies mostly in two bars, and which is about three-quarters of a mile in length by full four hundred feet in average width, and about 20 feet in depth. This ground has been prospected sufficiently to satisfy the company that throughout its entire extent it is highly auriferous, and will pay large wages whenever it can be properly drained. In the summer of '52, a company was formed to cut a tunnel through this mass of rocks, or dam, from the lower side, for the purpose of draining the bed and banks above. This company have just completed their labor, and had barely time to obtain a few highly satisfactory prospects, when the rains set in, and by the rising of the river drove them from their work. So great was this discouragement that no further efforts were made to work the ground, other than by a little surface labor on the bars above, until early the present season, when a company was formed in this place, for the purpose of working it. This company was organized chiefly under the direction of Mr. N. L. Gebhart, and have commenced the herculean task of making an open cut through this mass of bed rock, a distance of about 100 feet in length. This cut is to be 20 feet in the clear on the bottom, and through it the river is to be turned, and the sluices worked.

The estimated cost of opening the claims was originally placed at $25,000, and the stock was divided into 200 shares of $250 each. The work is now more than half completed at a cost of only $9,000. Only 100 shares have been sold, and the company now refuse to sell any more. Their operations are now under the immediate control of Mr. Gebhart as Superintendent, who has associated with him, as Directors, Mr. John Blackford, Mr. J. C. Ball, Capt. John Day, and J. A. Rogers, all of this place.

The company expect to commence washing in about six weeks, and will doubtless be able to continue their operations nearly all the time, winter and summer. It will require, at the least calculation, the labor of 100 men 10 years to work out the ground of the company. We have little doubt but that the enterprise will prove highly profitable, and it certainly affords additional evidence, that the mines of California are not yet quite exhausted.

AUSTRALIAN GOLD FIELDS.

The export duty on gold had come into operation on May 1, and owing to the forms connected with it, a temporary diminution had occurred in the quantity brought into Melbourne, although the rate of production was understood to be undiminished. The efforts made previously to send away as much

as possible, had also contributed to a re-action. The totals received by escort in the seven weeks from April 14th to May 26th inclusive, had been 44,356, 41,782, 52,174, 13,151, (the first week of the duty), 29,276, 30,364, and 47,402 ozs. The success of the Chinese had been remarkable, and several of them were returning to China with large amounts. In the previous week 33 had sailed with 740*l.* each in gold dust, besides specie and other valuables. The price of gold was 75s. 6d. per ounce. On May 23 the Melbourne banks increased the premium on the exchange on London, from 1 to 2 per cent. The produce of the gold duty for the four weeks it had been in operation was 14,419*l.* A plan of Mrs. Chisholm for the erection of shelter sheds on the roads to the mines, at from 5 to 9 miles apart, had been adopted by the Government, and a supply had been ordered for the first 30 miles out of Melbourne.

EXPERIMENTS ON QUARTZ SAMPLES.

All these, with the exception of two or three, were admixed with more or less of mundic, blende, copper pyrites, galena, &c.

The first column shows the weight of the sample operated on, the second the yield of fine gold per ton, and the third of the amount of gold per ton in the tailings:—

Cwts. qrs. lbs.	Ozs. dts. grs.	Grains.
0 0 5	1 8 0	4½
0 0 5	2 16 0	5½
1 0 21	0 3 14	3½
0 0 25	0 7 2	4½
0 1 4	0 3 22	3¾
0 1 22	0 6 11	5
2 0 0	0 2 6	4
0 0 4	0 2 8	2½
2 0 0	0 1 5	2¼
2 0 0	0 4 2	5
2 0 0	0 0 8	2½
2 0 0	0 0 6	2
2 0 0	0 1 12	3½
1 0 0	0 4 10	5¼
0 0 23	0 3 4	3¾
0 3 21	0 1 12	3
0 0 24	0 0 7	3
1 0 0	0 6 10	5½
0 0 14	3 17 8	4
0 0 23	traces	traces
0 1 7	0 8 22	2½
1 0 14	0 1 2	traces
0 1 23	0 3 2	1½
0 1 1	0 6 10	3¼
0 1 21	0 4 23	3
0 0 26	0 1 16	3

Average amount of gold in tailings, 3 18-100ths grains per ton.

SAMPLE OF SPATHOSE IRON.

2 0 0	0 0 15	2½

SAMPLES OF MUNDIC.

0 3 8	0 2 0	4½
0 3 15	0 0 22	3½
0 2 0	0 10 0	4

Average amount of gold per ton in tailings, 4 grains.

IRON PYRITES, WITH GOSSANY QUARTZ.

2 0 0	0 0 2½	2
2 0 0	0 0 6	1½
2 0 0	0 0 3½	1½
1 0 0	0 1 18	3½
2 3 0	0 0 8	2¼
3 0 0	0 1 7	traces
3 0 0	0 0 6	traces
3 0 0	0 1 4	traces
1 0 14	0 1 2	4

Average amount of gold per ton of tailings, 1½ grains.

COPPER PYRITES SAMPLES.

Cwts.	qrs.	lbs.	Ozs.	dts.	grs.	Grains.
0	0	9	0	8	7	$4\frac{1}{4}$
0	3	21	0	1	12	$8\frac{3}{4}$
0	0	11	0	5	2	$2\frac{1}{4}$
0	0	4	8	3	8	$5\frac{1}{4}$
0	1	5	0	4	4	$8\frac{1}{4}$
0	1	26	0	0	21	$8\frac{1}{4}$
0	2	0	0	6	11	4

Average amount of gold per ton of tailings, 3 8-10ths grains.

BLENDE SAMPLES.

1	0	0	0	7	0	$4\frac{3}{4}$
2	0	0	traces			traces

SILVER-LEAD SAMPLES.

2	0	0	0	6	21	5
2	0	0	0	1	21	4
0	1	8	0	17	14	$8\frac{1}{4}$

Average amount of gold per ton of tailings, 4 2-10ths grains.

TIN STONE.

3	2	0	2	1	4	$4\frac{3}{4}$

SURPHATE OF BARYTES.

0	2	0	0	16	17	$5\frac{1}{4}$

GOSSAN.

4	1	0	0	0	22	4

J. Mitchell, in London mining Journal.

EXTRACTION OF GOLD BY MERCURY.

That practically all the gold can be extracted by a proper mercurial treatment, I have abundantly proved by many hundred experiments upon nearly every class of auriferous matter, in quantities varying from 8 or 10 lbs. to as many tons. A statement of some of my many experiments, I published more particularly with the view of proving that all classes of minerals might be submitted advantageously to my process, whether they were pyrites, blendes, galenas, or otherwise, and that the quantity of gold remaining in the tailings was insignificant. I do not, however, propose to so completely strip the tailings in regular work, as the last pennyweight per ton does not pay working cost.

I can further state that I have never found any difficulty in the treatment by amalgamation, nor have I met with any one accustomed to the treatment of gold-bearing minerals who has found any insurmountable difficulty in the matter. All that is required is, that the ore shall be very finely divided, that it shall actually come in contact with the mercury, and that the amalgamating apparatus shall be so contrived that the gold remains in contact with the mercury until it is dissolved. Moreover, the apparatus should be so arranged, that a certain amount of chemical action should be set up, so as to increase the solvent and decomposing power of the mercury. All this I have accomplished in my mode of working. From the experience I have had in the treatment of many hundred tons of a variety of mineral matters during the years my attention has been called to this subject, it is no longer to me a matter of doubt, as I shall be glad to demonstrate to those who are actuated by more than idle curiosity in the matter.

THE AMERICAN MINING MILL.

We briefly mentioned in our last issue, the invention of Heman Gardiner for the *crushing, pulverizing, and amalgamating of ores.* The brevity of the notice would prevent the reader from obtaining a very clear view of the in-

vention, and we therefore refer to it again, especially as one or two inaccuracies were inadvertently contained in that statement.

Mr. Gardiner has been experimenting for many years, and has produced and patented a piece of mechanism of peculiar merit. The following is a succinct description of the machine and its *modus operandi*, to which we shall take a future occasion to refer more in detail.

It is a new mill for grinding and separating gold-bearing quartz and other ores, and is a combination of old and well-tried principles. It consists of a large cast iron basin, or kettle, which rises conically in the centre, and is supported on a foundation of masonry, by means of a pedestal, with a ball or cone-shaped end, of such a height, that when the kettle is placed on the pedestal, it is elevated about twelve inches above the foundation. In the kettle is placed a large cast iron ball, weighing from two to four tons. The ball depresses the side of the kettle, in which it rests, on to the foundation, which supports its entire weight. The kettle is tilted, or depressed, on each side in its turn, by means of an arm and roller, running upon a flange upon the outer edge, or rim, of the kettle, which causes the ball to roll around the kettle with great rapidity. The ore is received in this kettle in large lumps, and crushed to a very coarse sand. It is then discharged from the kettle, through apertures in its sides, into four separate mills attached. These mills are composed of the hardest kind of French burr stone—the nether, or lower stone, is about twelve inches larger in diameter than the upper. There is a curb, or hoop, closely fitted around the lower stone, of a height equal to the thickness of the two stones, forming a chamber, or recess, all around the upper stone, of about six inches in width. In this chamber is deposited a bath of mercury, and, as the ground ore is discharged from between the stones, it is brought into immediate contact with the mercury at bottom, and rises directly up through it. The gold being taken up by the mercury, the more earthy part of the ore, or rock, incorporates itself with the flow of water which is constantly running into the mill, and continues to rise to an aperture near the top of the hoop, through which it passes off, while the gold and mercury are retained by their specific gravity at the bottom. The mills are simple in construction, and effective in their merits. A full-sized mill, of four pairs of tones, is designed to crush and grind about fifteen bushels of quartz rock perd hour to each pair of stones. They are easily worked by any. The machine is especially adapted to gold ores, but they are constructed for the crushing and pulverizing of every description of mineral.

A company, called the American Mining Mill Manufacturing Company, with ample capital, has been organized, for the manufacture of these machines on an extensive scale. They have opened an office for the exhibition of models and the reception of orders, in this city. They have, also, a complete machine on exhibition at their manufactory, to which those interested are allowed admission.

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

The latest reports from this region present the following facts:

At Eagle River the mines are looking exceedingly well. The North-western mine is working a force of 90 men all told, 88 of whom are miners. They are running sixteen heads of stamps, and expect to ship the present season about 90 tons of copper.

At the Central mine the indications are of the most favorable character. The first work done on this location was commenced about the 15th of November last, since which time the mine has continued to improve in appearance and richness, and it is confidently expected by the Agent that 75 or 80 tons of Mass and Barrel copper will be raised from it the present season.

There is a great deal of animation among the mines in the Outonagon District, and the indications of a profitable investment never looked more encouraging than now.

The Adventure mine raised during the month of August 19 tons 752 pounds of copper, with a force of 64 miners. This mine is worked upon the tribute system, the miners receiving $120 for each ton of copper raised by them, and we understand this percentage enables them to make good wages. The success attending this system of mining, has induced other mines, situated on the Evergreen Bluff, to adopt the same policy, and we expect soon to learn of further developments there. The only objection to this process of working is the trouble of confining the miners to any particular locality, so as to thoroughly prove up the mine; but in case of the Adventure, we are informed by Mr. Mason their Agent, that the work is prosecuted at such points and in such a manner as he sees fit to designate.

The Merchants' mine, adjoining the Adventure, and on the same bluff, are working a small force on the tribute system, but with what success remains to be seen, as the party engaged have but just commenced operations, and not yet had time to try their fortune.

The Nebraska is increasing in its prospects every day. They have lately commenced the sinking of a new shaft on top of the Bluff, with the most gratifying results.

It is but about two years since operations were commenced here, and in that time over 25 tons of copper have gone forward as the product of the mine, and in addition to which the agent intends shipping the present season from 4 to 6 tons more. There has been several very fine specimens of silver taken from this mine, nearly as large as a hen's egg, and quite pure.

Portage Lake Mines.—That this region is all that it has been represented, there can be no doubt. The effect upon the stock of the companies will be very good, and we may soon look to Portage Lake for extensive workings and large shipments.

Eight men began from the surface on the Pewabic location, April first, and took out, up to July 15th, thirteen tons of copper, which has been melted at Cleveland and yielded over sixty per cent. of Ingot Copper. From the 15th of July to August 15th, they took out five and a half tons, which is now barrelled up, and on the dock at Portage Lake. This will yield 70 per cent. as some of the barrels weigh over 890 lbs. The shaft is now down forty feet. This vein was discovered in February last, and has been explored about a mile in length with the same appearance in richness where it has been opened. On the Quincy location a party of men have worked the same vein a part of the time since April, and have obtained for the time they had worked, an equal amount of copper. If the stamp work on the Pewabic location was dressed, the total yield would not have fallen short of 25 tons.—*Lake Superior Journal.*

Minnesota Mine.—Some particulars of interest relative to the Minnesota, Toltec, Isle Royale, &c., are published by the Boston press, which are quite flattering:—

The copper product of Lake Superior this year will not be less than 2,500 tons of pure copper, worth more than a million and a quarter of dollars. The "Minnesota," that earned and paid last year a dividend of $30 per share, has this year increased its product 60 per cent. above that of the corresponding months of 1854. The "Cliff" mine (Boston and Pittsburg) has just declared a semi-annual dividend of eight dollars per share, and its monthly product since January 1, 1855, has exceeded 100 tons of rough copper. In this mine the miners are now exposing the largest mass of virgin copper ever discovered in the world. It is 200 feet in length, and is estimated to weigh 500 tons.

In the "Toltec" mine, also, a mass has been found of great size, considering its small distance from the surface. It is not yet entirely exposed, but the lowest estimate of its weight is 30 tons, and it is probable that it weighs much more. The 32 heads of stamps at the Toltec are now in full operation. They are now engaged upon the vein stuff taken near the surface. That which is now obtained is of a very rich quality, and the future monthly product of the Toltec in mass, barrel and stamp-work, of all qualities may be safely set down at 30 tons. The product of the year 1856 will largely exceed this. It is considered that about $60,000 per annum, is an ample sum to work a tolerably rich and well equipped mine to a moderate extent, say to the production of from 300 to 500 tons of rough metal. A mine therefore, like the Toltec, that can produce 360 tons of rough copper per annum, is really earning a dividend of two dollars per share, although that dividend may be deferred for a season by the difficulty of getting the metal to market, and by the necessity of taking the avails thereof to "finish up" the mines, in lieu of calling upon the proprietors for assessments. Of course, the expenditure of the mine increases with the product; but if it is rich in barrel work and masses, and the mine systematically developed, the percentage of increase in expenses is comparatively light after a product of 200 tons, or $60,000 is obtained. Thus a mine producing 500 tons of rough copper per annum would probably make a net profit of $60,000 or $70,000. It is difficult to make an exact estimate of mining profits, since the quality of each vein is different from all others, while there are various systems of management and numberless degrees of excellence. But we believe our figures are rather within than without the truth, and indeed many of those who should be best informed upon the matter, will consider our estimates of profits altogether small.

The actual shipments of the Toltec this season will exceed one hundred tons. About sixty tons have already been received.

Second to none of the non-dividend mines in product and in prospects, is the "Isle Royale." Ever since this vein was first discovered, many have predicted that it would speedily "give out." They declared that it was a bed and not a vein at all. It has not yet been exhausted, however, and the third level, as appears by recent letters from the superintendent, is quite as rich as any thing above it. Sixteen heads of stamps have been in operation for some months, and eight heads additional are now running. By the end of August thirty-two heads will be in full operation. Since the opening of navigation, 138 tons of rough copper have been received in Boston from the Isle Royale. This quantity is now in the hands of the Revere Copper Company for smelting and sale. The superintendent promises thirty tons monthly until the close of navigation. The actual product of July, with but one week's use of sixteen heads of stamps, was thirty-two tons. The "Isle Royale" is working on a very wide, but rather irregular vein, in point of evenness of the ground. It is interspersed with bunches of copper of great size and richness. Since January, the directors settled accounts with the former superintendent, and the company is $15,000 to $20,000 better off than it was stated to be in the annual report. Both the "Toltec" and "Isle Royale" companies will strenuously endeavor to get along without further assessments, although it is not impossible with the

divers accidents and delays incident to a distant business a moderate sum may be required to carry them through the coming winter.

"The "Toltec" vein is of great length and regularity, and is a prime favorite of all the visitors to the copper country. The "Isle Royale" in addition to the fine vein upon which the company is now working, has the famous "Portage" vein running parallel to the "Isle Royale."

"The "Forest" mine has disappointed many people, in consequence of its large expenditure and its delay in dividends. The treasurer, however, writes us that "in his opinion, after a careful investigation of the mine and its resources, during a visit of several weeks, it only requires the stockholders to be true to their interest in the vigorous prosecution of mining work to bring it to a highly profitable result." Steam power has recently been substituted for horse power with great advantage. The treasurer writes that all the requisite machinery and surface improvements, which have necessarily involved a heavy outlay, are now completed, and the whole working force of the mine is applied directly to mining and stamping.

The produce of the mine from the 1st of January last to the month of July. amounts to 206,261 lbs., made up of the following descriptions, viz.

Masses,	5,563 lbs.
Barrel work,	75,751 "
Heads, or cover work,	42,651 "
No 1 stamp work'	63,785 "
No 2 do.	18,245 "

I beg to call your particular attention to this classification of the yield of the vein, as there is an erroneous impression abroad that the Forest vein is simply a stamp work vein, and these facts now given you will refute that impression. The proportion of mass, barrel and cover work, as shown by six months' working of the mine, includes 60 per cent. of the copper taken from the vein.

By a detailed statement made from the office of the Revere Copper Company, it appears that the smelting of the first lot of the Isle Royale copper, esulted as follows:—

Invoiced weight of rough copper	189,301 lbs.
Actual " "	195,685 lbs.
" " pure metal	184,745 lbs.

This gives a yield of 69 per cent. of pure metal, exclusive of the slag, estimated to yield 5 per cent. more.

Antiquities of Lake Superior.—In excavating near the mouth of Carp River, Marquette County, in what appeared to be the ancient bed of the river, (situated about ten feet above the present bed,) various instruments and tools of copper have been found, such as knives, chisels, bodkins (or a tool similar to a bodkin), also arrow-heads or barbs, such as are used by the Indians in their wild state where they cannot get guns, also chips and pieces of copper, apparently left for the manufacture of the above-named tools. We have examined some of the tools and implements, and have in our possession a knife obtained from the excavation referred to. Large pine trees stood over the place where the knife was obtained, at least one hundred years old. How long the knife and other implements had lain there is hard to tell, but suppose it must have been several hundred years, as a long time must have elapsed before the river bed of gravel could have been formed, and subsequently changed, the soil deposited on the gravel bed to the depth of two feet, and the pine to take root, and grow to one hundred years old. The knife referred to is about seven inches long, shank and all, the shank two and a half inches and the blade four and a half inches long. It is made of copper, with pieces of silver attached, as we see in specimens procured from the mines now being worked in the country. In shape the knife corresponds very well to those generally used and preferred by the natives of the country, viz., with an oval blade.

It also appears to be a fancy knife, tipped off with silver from point to shank; it is also very hard for copper, so much so that it is difficult to bend it without breaking. This fact goes to show that the manufacturer, whoever he may have been, understood the process of hardening copper. The same fact holds good in relation to the other implements. To prove the fact that these implements had been hardened, and that their hardness is not due to any chemical change that might have taken place subsequent to their deposit in the river bed, we have only to compare them with the shavings and chips found with them, and probably a part of the original piece from which they were manufactured. These chips or shavings are perfectly malleable, the same as we find the native copper obtained from the present mines. Consequently, if any change had taken place, it must have, or probably would have produced a corresponding change in the chips or shavings. In fact, the existence of these shavings, proves that they must have had some tools harder than the malleable copper, and thinner than those ordinarily made of stone, as some of these shavings are very thin, and have the appearance of being cut with some sharp tool. The socket to the chisel or bodkin (for we know of no better name to call it), was formed by hammering the copper out flat, and turning this, forms the socket. The socket is not welded or soldered, proving that the manufacturer did not understand that art.

The present native races in the country have no knowledge of the people who manufactured these implements and worked the Copper Mines of Lake Superior hundreds of years ago. At the mouth of the river above referred to are abundant evidences to show that there has been a town or village there many years ago. These evidences consist in the fact that lines of houses can be traced by the stones and clay intermingled that formed their chimneys and fireplaces. The outlines of the buildings are traceable in the ridge of clay that has fallen from their decayed walls. These were probably composed of logs, and pointed or plastered with the clay that now indicates their existence. These indications exist on the ground where the forest, a few years since, waved in its majesty of a hundred years' growth, but now have given way to other occupants, hitherto unknown in that land. The strong probability is, that the inhabitants of these dwellings were the manufacturers of the implements above referred to, and that they were lost in the river by them, while engaged in the common avocations of life.—*L. S. Journal.*

COPPER IN CARROLL COUNTY, VIRGINIA.

There are several mines in Carroll Co. Virginia, which are yielding copper ore, of some of which we are able, through Mr. Jacob Peck, to furnish a few particulars.

The first workable copper lode in the property of the "Tennessee and Virginia Co.," was reached 19th October, '54—in an Adit cut 180 feet at Cranberry (the Early property). The lode has been followed about 275 feet, and of the lode only about 6 feet taken out, the whole lead of ore so far as explored gives a width of from 20 to 30 feet.—Of what may be, below the present level, we cannot as yet speak. But an under Adit now cutting (some 25 feet) below the former, will soon make the disclosure.

There has been taken out and sold in market 200 tons copper ore averaging 26 per cent., and above that about 75 tons on the way to market.

The Cranberry or Early property has been the most expensive; it was the first in the development operated on; modes of working were new to the adventurers and hands employed; operations at several points were commenced and abandoned. Had all the work done been concentrated, copper would have been sooner reached, and expenditure saved.

This mine however, has paid all the outlay, and able to make a small dividend. The fixtures for carrying on the work are decidedly good. A large boarding-house, and suitable cabins for miners, a good supply of provisions, &c.

The next property brought to a workable condition, has had given to it the euphonious name of the Wild Cat.

This property when opened is not exceeding half a mile from the Cranberry. Mr. Bachman, as I understand, located the point first operated on, copper was soon reached at an expense not exceeding $30, and since late in the month of February last there has been taken out, sent off and sold, or on the way to market about 78 tons—and in shed for boxing 20 tons of superior ore, thought to be somewhat richer than the Cranberry. It is easily obtained, and judging from the small space explored gives every promise of an exceedingly rich mine. The gossan capping the lode at this mine is very red, unusually so; not ten days ago in making an assay for copper ore, some dark ores taken from this mine, the specimen was found so lean in copper, trial was made on the same ore for silver, when to the agreeable surprise of the experimenter it gave the silver test strong and satisfactory.—Many trials have since been made with like favorable results. Experiments will be followed up in other forms and on a larger scale.

Tons of this ore had been taken out of the mine, the heaviest broken up and boxed with the copper ore, and portions the lightest cast off as rubbish.

This silver ore, for it is such, is a Black Sulphuret, with crystals of Red Silver, and Silver glance; some specimens dark blue, with clusters of small shining mamils are beautiful.

It is found mixed in the vein or lead with the ores of Copper, but the best marked and most abundant, as the workmen tell us, is found at the margin and underside of the lead. Should it continue abundant, as the raising of ore is continued in other parts of the mine, it certainly will be important to know its value, have the ores as taken out, manipulated, and the more valuable saved. In this ore of silver, I found gold visible to the eye, but as yet have not separated any. There is every mark of gold in these mines.

The Ann Phipps mine, of the three worked has been the last opened. The ore there was found near the surface, is very rich—a large mass of it, at least 1,800 lbs., is kept under shed, it is a fine block as yet held out for show.

Out of this mine in a few months, since the 10th April, there has been taken and sent off 165 boxes, and 100 supposed to be on hand, at about four boxes to the ton, 66 tons. These numbers throughout are given as approximations, but I am assured by those who know, not above actual quantities.

In this mine as yet we have no report of silver ores; but it may be remarked they are all on the same great lead—surface indications alike, and no very marked distinction in the ore (except want of silver in this) less development here than at the others leaves no room to doubt of its existence here, and indeed in all well marked parts of this lane.

From those who have taken the ore to market we learn that with smelting, this ore is desirable—and when that on the way shall be disposed of, upwards of $30,000, will have been netted, and this in a few months, for much of winter from severity of weather was lost.

Several other of the mines of the company have been opened, all so recent that copper raising as yet has not been commenced, of these in a future number I may give you some account.

It is not to be understood, that these I have mentioned, as in operation, are the only localities producing and sending ore to market. A mine owned by Messrs. Rhea & Co., and one also by Messrs. Stuart & Co.; the Dalton property Pierce & Co., all near Cranberry. Yarnell & Co., with others near "Old Grayson Court House," have all raised and sent more or less.

The outlay in working the mines or any one of them—the number of hands employed at any or all—the lift of ore in the day or week—the cost of transit to market, &c., are subjects for the occupation of more time than I can now devote to them.

SULPHUR IN COPPER ORES.

The loss of the sulphur in the copper ores smelted in this country, has hardly begun to receive attention. The number of smelting establishments is

quite limited as well as the amount of ore smelted. Even in England but little attention has been paid to it. Its importance, however, and the value of lost sulphur may be estimated from the following statements of a correspondent in a number of the London Mining Journal.

First, as to quantity. The amount of copper ores sold at Swansea and in Cornwall by public sales, during the year ending July, 1858, is reported at 209,335 tons, and if we add to this the amount smelted at St. Helens, Amlwch, and other places, as 20,665 tons, we have a grand total of 230,000 tons of ore, which, at the low average per centage of 15, gives the result as 34,500 tons of sulphur annually lost to the country. Mr. Napier, in the *Philosophical Magazine*, estimates the annual loss at Swansea alone as 30,000 tons; and I think Le Play estimates it a little higher, as he gives the average per centage of sulphur in the ores smelted in certain works as 23. Second, as to value. Suppose we take the lowest estimate, and call the amount 30,000 tons, the average price of brimstone cannot be reckoned as less than 6*l.* per ton; the annual loss in money value is then 180,000*l.*; which, as Mr. Napier remarks, "somewhat reflects upon us as practical men, willing to turn every thing to account." But the matter does not end here, for the annual amount of damage done to the surrounding country by the destruction of vegetation, &c., must also be taken into account. The smelters have tried by various means to reduce this nuisance, and have succeeded, to a very limited extent, with the arsenic, zinc, &c., but totally failed as to the condensation of the solid sulphur. The analyses by Mr. P. Johnson of the deposits from the long culvert at Cwm Avon, lately published, demonstrate this fact. Even the results obtained at Amlwch from very rich sulphur ores are very defective, and yield a very small per centage of the sulphur contained in the ores. When I was last there, the only means of obtaining solid sulphur that I saw in operation was from the crust of sulphur that collected on the outside of the burning piles of ore, which only showed that the circulation of air through the pile was defective. It would be interesting to learn how many tons of solid sulphur can be produced from 100 tons of ore, and the per centage of sulphur the ore contains. My own opinion is, that from 100 tons of ore, containing 35 tons of sulphur, not more than 3 tons of solid brimstone is released.

Sulphur is found in copper ores always in combination with the iron and copper, and consequently cannot be separated by distillation. When the ores are very rich in sulphur, a small proportion of the sulphur might be sublimed, but not sufficient to make the process remunerative. From copper ores in usual practice, the great proportion of the sulphur is eliminated, both in the process of calcination and roasting, as sulphurous acid. This, to be useful, must either be further oxidized to sulphuric acid, or reduced to the solid sulphur. That the state of sulphuric acid is the preferable one in which to realize the sulphur, will be apparent from the following facts:—Sulphurous acid being a combination of two atoms of oxygen and one of sulphur, and as it is eliminated from copper ores under the most advantageous circumstances, is largely mixed with hot air, hence necessitates a very large expenditure of reducing agent. The result, moreover, is simply solid sulphur, which, in nine cases out of ten, is again converted into sulphurous acid, for the purpose of manufacturing sulphuric acid, which is the state into which nearly all the sulphur imported into this country is immediately converted. But, further, the conversion of sulphurous acid into sulphuric acid is much easier and cheaper than can be its conversion into sulphur, for the large admixture of heated air is an advantage rather than otherwise, as the object is futher to oxidize, not reduce. Again, as to value, the present price of sulphur is not quite 6*l.* per ton, and the price of sulphuric acid is at least 5*l.* 5*s.* per ton net: 1 ton of sulphur will make more than 2½ tons of sulphuric acid. We have thus the money value represented as, sulphur 6*l.*; sulphuric acid, 13*l.* 2*s.* 6*d.*; and I will venture to say the cost of manufacturing the 2½ tons of sulphuric acid will be much less than that of the 1 ton of sulphur, if the latter can be done

at all. If the whole 80,000 tons were thus converted into sulphuric acid, it would amount to 423,500*l.* The surplus looks small beside this sum. When we consider that an ore containing 2 per cent. of copper and 40 per cent. of sulphur represents in value per 100 tons (without at present taking into account the cost of manufacture) as follows—viz.: 2 tons of copper, at 126*l.* —252*l.*; 100 tons sulphuric acid, at 5*l.* 5s.—525l.—it will be seen in a moment what an immense loss arises in treating these poor ores by the usual processes.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

IMPROVEMENTS IN REDUCING LEAD AND COPPER ORES.

IT has long been an acknowledged fact, that the processes which have been for so many years, and still are, adopted in the smelting of copper and lead ores, possess many disadvantages, and are conducive to a very great loss in metal. Many have been the suggestions for improvement, but the large smelting houses at Swansea (England), in whose footsteps the rest of the world follows, content to let large profits alone, have ever set their faces against what we suppose they considered an innovation. In the common reverberatory furnace much mischief frequently arises during the early part of the calcining process, and particularly with refractory ores, highly charged with sulphur, zinc, and antimony, from the overheating of the furnace, when a partial fusion of the ores of some metals take place, which cannot be repaired, in most instances, but with great loss. Workmen not practically acquainted with furnace management often do much mischief, particularly in adding large quantities of quicklime, than which nothing can be more injurious. It absorbs an immense quantity of protoxide of lead, which cannot be reduced on the slag hearth, or by any other means, but with great loss. This mischief cannot well occur in the Patent Double Reverberatory Furnace, recently patented by Mr. Alfred Jenkins, formerly of Swansea, which we are about to describe, even with furnacemen of little experience, and the average loss of lead will be found not to exceed 5 per cent. with all ordinary ore. It consists of the ordinary fire-grate, the heated air and products of combustion passing into the flowing furnace, from which there are two passages leading into the calcining furnace; between these there are dampers, which can be closed when all the heat is required in the flowing furnace, and others opened, by which the gases are conducted underground to the chimney. When the heat is carried through the calcining furnace, the central flue-dampers are closed, and two passages at the extremity conduct the gases to the main flue or chimney shaft. The ore to be calcined is fed through a hopper over the calcining furnace, the calcined ore removed through an aperture in the bed, and fed in a similar manner to the flowing furnace. An air or ventilating space is left between the two furnaces, in order to prevent the bed of the flowing furnace from becoming overheated. A small chimney at the end of the fire-bars serves to carry off any dust or ashes from the fire when fresh fuel is added, or when otherwise agitated; and the air-blast is supplied through apertures at the sides. Various advantages are derived from the use of this double reverberatory furnace. In the first place, the waste heat, after passing off from the flowing furnace, is economized, and employed for calcining the ore, instead of additional fuel being required for the purpose; while a slight portion of uncombined oxygen accompanies the waste heat from the flowing

furnace, to act on the ore in the calcining furnace, rendering it more easily worked, however refractory. As two charges of ore, weighing from 48 to 50 cwts. are always being operated on at the same time—one in the first, the other in the second stage, and with one ordinary fire—an immense saving of fuel is the result. The patentee is erecting his first double furnace at Arkindale, near Richmond, Yorkshire, the company feeling convinced it was high time to do away with the old extravagant mode of smelting.

TREATMENT OF PYRITIC ORES CONTAINING SILVER AND COPPER WITH AN EXCESS OF ZINC.

When ores consisting chiefly of iron pyrites, and containing traces of copper and silver, are smelted in the blast-furnace in a semi-roasted condition alone, with proper fluxes, so that a copper matte may be obtained in which the amount of copper and silver is worth extraction, it is possible to drive off a large amount of zinc (originating from blende), and thus obtain a matte fit for treatment with lead, by fusion—*e. g.*, with argentiferous galena and earthy silver ores. When the smelting is conducted in a furnace with open breast, and the blast is sent horizontally into the melting-chamber, the zinc is driven off in vapor and oxidized. Thus, a matte is obtained, presenting, when cool, an orange yellow fracture with faint lustre, and consisting of sulphides of copper and iron, with silver, and occasionally lead. The amount of zinc is rarely 8 per cent. But if the ore be smelted in a partially roasted state in a reverberatory furnace, the blende is not decomposed, and passes chiefly into the matte, which when cool is hard, black and feeble lustre, and granular micaceous fracture. The zinc may amount to 20 per cent. Where zinc is abundant, the roasting is far more difficult and tedious. It may, however, be decomposed, by being heated with oxide of iron in fine powder. Thus, if the pyrites to be smelted should contain a large proportion of black blende, which contains 23 parts sulphuret of iron with 77 sulphuret of zinc (the latter containing 51-6 zinc with 25-4 of sulphuret), and it is wished to drive off the zinc, 63-4 parts red oxide must be added, and 7-1 parts of carbon, for its reduction. From various causes, these proportions should be rather exceeded in practice, as—*e. g.*, 70 parts oxide of iron and 10 parts of coal dust. The addition of slags containing protoxide of iron and mono-silicates, such as the slags from smelting with lead, or well-roasted pyrites, is generally useful. If alumina is deficient, silicious clay should be added; and if lime is wanting, quick-lime or fluor spar; the latter is particularly valuable. If the oxide of iron be used for decomposing to blende by roasting a pyritic ore containing blende, the operation must be performed in a reverberatory furnace upon the ore in fine powder, at a temperature of 800°, attained gradually, and with a plentiful admission of air.

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

	Tons.
Shipments by Reading Railroad, to September 20th .	1,744,592 04
" Schuylkill Canal, ...	777,118 12
Total	2,521,710 16
Same time last year	2,245,182 06
Increase thus far in 1855	276,528 10

LEHIGH COAL SHIPMENTS TO SEPT. 15TH.

Summit Mines,	288,474 06
East Lehigh,	81,889 17
Room Run Mines,	58,222 04
Beaver Meadow,	88,168 00
Spring Mountain Coal,	122,855 17
Colerain Coal,	67,909 19
Stafford Coal,	7,874 17
East Sugar Loaf Company,	85,439 15
New York and Lehigh Company,	25,789 10
French American Coal Company,	4,817 06
A. Lathrop's Pea Coal,	2,411 09
Hazelton Coal Company,	111,002 04
Cranberry Coal Company,	55,977 11
Diamond Coal Company,	20,909 19
Buck Mountain Coal,	57,088 12
Wilkesbarre Coal Company,	82,896 11
Total,	902,281 18
Last year,	824,768 12
Increase in 1855,	77,518 01

CUMBERLAND COAL TRADE FOR 1855.

Shipments to September 15th	452,128 02
" to same time last year	444,850
" to September 10th 1858	810,128

Carbon per cent. of the Anthracites of Pennsylvania from Taylor's statistics on Coal, and other works on the same subject:

Veins and Localities.		Analyzed by Carbon.	per cent.
Mauch Chunk, Summit Mines,		Olmstead,	90.18
do	do	W. R. Johnson,	92.30
do	do	Kaisten,	86.00
do	do	M. C. Lea,	87.00
do	14 feet vein,	Rodgers,	88.00
Nesquehoning,			86.60
Tamaqua,	D. vein,	"	92.07
do	do	M. C. Lea,	91.00
do	E vein,	Rodgers,	89.20
do	R do	"	87.45
Pottsville,	average,	"	94.00
Forest Imp'vement	"	Johnson,	92.12
B'd Mountain, W. Branch,		"	93.00
do	Mine Hill,	C. T. Jackson,	92.12
Peach Mountain,		Johnson,	89.00
Peach Orchard,		"	92.00
Salem Vein,		Taylor,	93.00
Black Mine,		H. Lea,	88.40
Hazleton, Sugar Loaf,		Johnson,	90.70
Beaver Meadow, average		"	85.84
do do	slope 8,	"	91.64
do do	slope 5,	"	92.30
Ashland, Connor's Mam. coal.		per order,	97.00
Locust Mt. Coal & Iron Co.		Blake,	96.00
Lehigh, Summit Co.	1	W. R. Johnson,	87.48
do do	2	"	91.69
do do	3	"	86.06
Mauch Chunk,		Percy,	84.98
Buck Mountain,		W. R. Johnson,	91.02
Shamokin,		Rodgers,	89.90
West Mahanoy.		Taylor,	90.00
Wilkesbarre, Blacksmith Coal,		"	88.00
do	Nanticoke	"	89.00
do	Warden,	"	88.00
Wyoming,		J. F. Frazier,	91.20
Lackawanna, mean result.		Johnson,	88.98
Scranton,		Rodgers,	87.88
Carbondale,		"	90.20
Pinegrove,		Rodgers & others,	84.00

COAL MINING.*

From the shute at Pittston where they project the coal into canal boats, I went out one mile on the railway track of the "Pittston Company" to their mine. Entering their tunnel, I proceeded 200 feet, through strata of shale and slate, and then came to the fourteen feet vein they were working. Here was a large area excavated, the roof supported by square pillars of coal left for the purpose. These pillars were eight feet in diameter, which gave to the subterranean house an awful aspect. In mining, the operator begins at the centre of the perpendicular coal surface. He drills a hole horizontally five or six feet, not by striking the drill with a hammer, but by direct blows of the drill itself. Then putting in a charge of powder he blows out a quantity, more or less. Another and another charge on the same level clears the middle section of the three. The upper and lower sections are then wrought with half the labor. The large fragments are broken into pieces six or eight inches square, and by other hands carried to the car standing near by, ready to be drawn by a mule to the mouth of the tunnel, to descend thence to the shute by gravitation. The hole of five or six feet is drilled in ten or fifteen minutes, and a skilful miner will dislodge from eight to ten tons a day. Water drips from the roof and accumulates in the prepared gutters, and then runs off through the tunnel. In the shaft mine it is raised by an engine.

Value of coal lands.—No wonder that the owners of coal lands (lands, I mean, that they have been found *actually to contain coal*—not by any means all that are *supposed*, or *said* to contain it), should believe their property in this vicinity to be of incalculable value, and hold it at such high prices. If I were to state the immense incomes of some of these gentlemen, merely from the lease of their lands at a given sum for each ton of coal taken out from the mines, the story would seem *fabulous!* Beyond all doubt, the largest fortunes of the country are to be possessed by the fortunate owners of coal lands of this vicinity.

Cheapness of coal.—It is all important that coal should be cheaper than it is throughout the country, and especially in our large cities. But this can never be the case till the cost of transportation is diminished; for the expense of mining, and of course the value of the coal at the mines, cannot be much lessened till new methods and machinery for excavation shall be devised; and the prices of coal will generally be found to vary with the prices of freights. Any decrease of the distance to market, then, will be a blessing alike to the consumer and producer—to the owners of the mines, and the vast and rapidly growing population and business that depend on coal for fuel.

PENNSYLVANIA COAL CO.

Returning on the track, I crossed that of the "Pennsylvanian Company's" road, whose shaft is in the Borough of Pittston, and whose mine partly underlies the Borough, and extends north and east for a considerable distance. Many acres have already be excavated, and their whole bed, the guide said, amounted to 2000 acres. This Company, not to be deterred by the mountain ridges from reaching the market of New York City, built a railroad of their own from their shaft to Hawley, 48 miles, and an independent return track for unloaded cars back, making 96 miles of road. From Hawley they ship their coal on the slack-water navigation of the Lackawaxen, and on the Delaware and Hudson Canal, by Honesdale, and Port Jervis to the Hudson River at Roundout—from thence their boats are towed down to New York city. Their railroad to Hawley consists of twenty-two planes slightly inclined, and as many stationary engines to draw the cars up as many short planes of very steep ascent. As each long plane is reached the cars descend by gravitation towards the Hawley,—no locomotives being used. The return trip is by a similar process. Notwithstanding this large outlay for railroad and stationary power, and large toll for circuitous navigation, this Company's stock is above par, and the dividends eight per cent.

The operatives at the mine are near a thousand, and it seems strange, as one walks around Pittston, to think that beneath your feet, far down, there is such a population more busy and content than the crowd above. The shipments of this company for the week ending Aug. 4th, amounted to 13,099 tons, average per day, 2,183 tons.

In these mines, as well as walking or riding around on the surface, wherever a cut has been made, one has a fine opportunity to witness the phenomena of the coal formation. In this mine I noticed a large *fault*, that is, the entire strata had been split perpendicularly, and all on one side depressed ten feet, so that in working the vein the workmen would suddenly come against clear slate, as if the vein had ended. Then all work must stop to raise or depress the gangway, to get at the vein again.—*Corresp. Boston Traveller.*

THE TOWN OF JESSUP.

This young town is seven miles up the valley from Scranton, and consequently will have the advantage of some forty feet of elevation over that place, which will materially lessen the grade of their road in ascending to "Cobb's Gap," where it intersects with the Delaware, Lackawanna and Western Railroad, now fast approaching a completion, towards the York and Erie road, in connection with New York. The heavy ascending grades of these roads will be a great drawback in the transportation of Coal; and many consider that inclined planes would be preferable: but the road is well and substantially built—in fact, it has no superior in the world, both as regards the quality of the iron and the construction of the road—and the Locomotives in use are generally powerful and well built. They take twenty six ton cars—120 tons of Coal—up the heaviest grade from Scranton. I have not yet had time to examine thoroughly the Engineer's report, but I am told that the average grade from Scranton to Cobb's Gap—the summit of the road through the Moosic Mountains—is about eighty feet to the mile.

Jessup is three miles below Archibald, and nine miles below Carbondale, and consequently, ascending tothe geological for mation, as far as we have investigated, the basin here contains more Coal seams than it does at the last named place, but less than it does at Scranton. It is a well known fact—proven by the sad experience of too many—that veins of Coal vary both in quality and quantity in localities. In some places they are thick, while in others they are thin; in some places pure, and in others impure and faulty. In the first case this theory, or *fact*, holds good throughout the Great Northern Anthracite Valley; but in the second as it regards *faults*, they are indeed very rare. We could not say what may be the amount of Coal in the Lackawanna Railroad Company's lands; that can only be told by practical observation or investigation. Even Professors who pretend to see through things more dense than "stone walls," have been *considerably* at fault in this as in other regions, and people generally are disposed to laugh at the gravest assertions, when they relate to these *dark subjects*—those regions below.

There are two shafts being sunk at Jessup—known as the lower and the upper shafts. The upper shaft is now, the 20th June, 120 feet deep, having cut through two seams in that distance; one about three feet and a half thick and the other about two. They are now in the top slate of the nine feet vein, which is supposed to be the Pittston or Baltimore Coal, or No. 4 vein; consequently, if this theory be correct, there are still three veins below the Nine Foot vein; though it is generally supposed that these lower veins occasionally form one or two large ones or divide into even five small ones.

The lower shaft, approaching nearer to the centre of the basin, is now 80 feet deep and has been driven through three veins; first the "Grassy Island" vein, here about eight feet thick, and the two mentioned above, as being cut in the upper shaft.

The company intends to operate principally in the nine foot, or No. 4 vein.

The shafts are 10 by 14 feet in diameter, and well and substantially secured with heavy timber. Each shaft has a 40 horse power engine for hoisting and pumping. A breaker is to be put up immediately, which is to be driven by a twenty-five horse power engine. The natural position of the place is well adapted for such improvements, and we presume—though we are not sure—those advantages will be improved. We say "not sure," because so many seem blind or deaf to the hints of nature. We have calculated at random guesses, that a million of dollars might have been saved in Coal investments throughout the three Anthracite Coal fields, if architects had adapted their plans to the natural position of places.

Jessup is regularly laid out in town lots, and several neat houses are already built for workmen and others. There are also one or two stores, a large machine shop, &c., &c. The company will have every convenience for mining and shipping Coal when their improvements are completed, which will not be much earlier than next season.—*Pottsville Journal.*

SHAMOKIN COAL TRADE.

In the course of a few weeks the coal of Shamokin will have an outlet to Elmira and other portions of New York, *via* the Sunbury and Erie, and Williamsport and Elmira railroads. That portion of the Erie road connecting Sunbury and Milton, will be finished, and permanently opened for traffic, on the 20th inst. The bridge over the Susquehanna being unfinished, the coal cars will in the mean time be towed over by means of boats, furnished with rails so as to connect with the railways on both sides.

Mr. Diven, the intelligent President of the Elmira road, anticipates a coal trade of considerable magnitude over his own road; and due arrangements for its accommodation will be made at the earliest day.

Governor Bigler's management of the Sunbury and Erie road seems to have been thus far entirely successful. Not only is the portion now nearly complete between Sunbury and Williamsport, but arrangements have been effected to place a long link between the latter point and Erie under contract. This is to be done through parties interested in the bituminous coal districts of the Alleghany, which will find an outlet to the Lake over the road. The coal shipments at Erie are increasing annually, at a high percentage, and when the extensive fields of McKean and neighboring counties are fully opened, this trade will become one of the most important features in the commerce of the city. The following statistics of the receipts of Coal at that place, by canal, during corresponding months of the last and present years, are interesting. It should be remembered that last year the canal was opened on the 8th of April, and there was no interruption during the season, except such as resulted from dry weather; while this year the navigation did not open until the 22d of April, and has since been interrupted for five weeks at different times, by breaks occasioned by high water. Under such circumstances the increase may be regarded as a very handsome one, and showing a prosperous condition of the Erie Coal trade:

1854.	Tons.	1855.	Tons.
April and May,	27,870¼	April and May,	16,251¾
June,	16,613¼	June,	24,864¼
July,	12,789	July,	28,891¼
August,	11,779	August,	22,451¼
Total,	71,501⅝	Total,	86,458⅜

Total in favor of 1855, 14,956¾ tons.

THE KANAWHA COAL FIELDS.

Public attention has recently been called to the immense mineral wealth which is being rapidly developed in Western Virginia. The value of the

Cannel and Bituminous coal fields in the neighborhood of the Kanawha and its principal tributary, Coal River, is immeasurable.

Some idea may be formed of the prospective addition to our national resources, by adverting to the statistics of the Pennsylvania anthracite coal fields. As late as 1820 their mineral value was still undeveloped; but since that time 40,000,000 tons of coal, of the value of $160,000,000, have been sent to tidewaters. This statement was made in 1854, and a large amount may be added to the sum above stated for the year that has since elapsed, and the ratio is annually increasing. A similar result has been seen as to the Bituminous coal.

In 1845 about 3,000,000 bushels were sent from Pittsburg down the Ohio River. In 1852 upward of 10,000,000 bushels were sent. The increasing consumption of Bituminous coal by steamboats on the Ohio and Mississippi, will soon call for an amount far exceeding the total amount shipped for all purposes in the year last named. It is estimated that there are 700 steamboats on these rivers, of an aggregate of about 200,000 tons Custom House measurement, whose consumption of coal, if wood fuel were entirely dispensed with, would amount in a single season to 24,000,000 bushels. Again, in the city of Cincinnati in the year 1850, the amount consumed was 4,000,000 bushels; in 1853, 8,000,000 bushels; and a like increase has been going on in Louisville, Cleveland, and other places.

It is obvious that the supply must have been unequal to this advanced consumption but for the discovery of hitherto hidden resources. But in addition to the ordinary uses of coal as household fuel and for the generation of steam, another has been within a few years added, viz: the manufacture of gas.

In a valuable report made by Joseph Gill, Esq., State Engineer of Virginia, to the Coal River and Kanawha Mining and Manufacturing Company, the superiority of cannel coal for the production of gas is clearly shown; the primary object being to produce the greatest amount of pure gas from a certain weight or measure of coal; the secondary one of making coke, being in his view comparatively of little importance. "The great comparative percentage of pure volatilized carbon expended in brilliant flame in combustion, and its rapidity of ignition, serves to entitle it to the most decided preference for this purpose, especially when it is considered that the coal in these establishments is burnt rather to make gas than to produce coke." And he quotes the opinion of Mr. Parnell, an eminent English chemist, that cannel coal would generate a more highly combustible gas, and give us a brilliant light, in smaller quantity, without the production of so much heat as is developed by the combustion of the highly hydrogenated gas derived from the common kinds of coal.

The report above referred to is a production of more than ordinary merit, and furnishes many facts and scientific calculations of much interest.

In another report made by a committee of the Cannel Coal Company, of Coal River, we find some remarks on the value of the Cannel coal for the generation of steam as well as the production of gas. "The absence of sulphur and residuum, which in common coals prove so destructive to grate bars, speaks strongly in its favor, while the ready ignition and profuse flame is a desideratum in steamboat fuel. Its pre-eminence, however, above all other coals consists in its indestructibility, and the property it possesses of remaining uninjured or impaired by any length of exposure to the weather. Its freedom from the possibility of spontaneous combustion in the hold of vessels, is another important feature. All of the principal cities in the United States are now lighted with gas. In New York coal alone is used to produce gas, and this coal is now entirely imported in proportion of two thirds Cannel and one third Newcastle. In Philadelphia coal is chiefly used, and most of the supply is obtained from Virginia."

It seems providential, that as the use of gas is getting to be so general in this country, that the species of coal most serviceable for the production of

pure gas should have been discovered to so great an extent upon the tributaries of the Ohio. The most important of these in respect to coal is the Kanawha, which flows into the Ohio 264 miles below Pittsburg and 195 miles above Cincinnati. Coal River enters the Kanawha 48 miles above the mouth of the latter, up to which point (the junction of Coal and Kanawha) it is navigable the same period that the Ohio is, viz: eight to ten months of the year; and there is a daily line of steamboats between Charleston (on the Kanawha 12 miles above the mouth of Coal River) and Cincinnati.

The coal strata are chiefly found above the junction and entered across from river to river, cropping out in prodigal profusion from the sides of the broken hills which line the small streams flowing into those rivers. On one of these streams (Briar Creek) the formation of coal is in four or five successive strata, exhibited one above the other, as you go from the base to the summit of the hills, each of the strata being essentially distinct—the upper one being pure cannel, and the others bituminous of various quality.

Coal River is at times difficult of navigation, but by an arrangement of locks and dams which are in the process of being constructed, all the difficulties will be obviated, so that there will be an unobstructed outlet for vessels of the usual size from Peytona, which is 13 miles above Briar Creek, and 36 miles above the junction of Coal River with the Kanawha.

These statistics are of general interest. We see no occasion for jealousy between rival companies. There will be a market commensurate with all the enterprise and capital that can be brought to bear upon the extraction of these newly developed treasures of the West. We conclude with an extract from the report of the Virginia Board of Public Works for 1851:

"Statistics of Western trade have been so often and from so many sources laid before the public, that to exhibit them here would be a useless repetition. They but teach the great fact of the country's unlimited capacity, when fully populated, for the production of human food and mineral treasure. This immense capacity for production has caused an increase of population such as the world never witnessed before, and reciprocally this astonishing increase of population has multiplied its material wealth with a rapidity outstripping all previous computation."—*New York Tribune.*

VENTILATION OF COAL MINES.

This is the point of the greatest importance in the working of extensive collieries, and indeed its necessity is more and more felt every year as the work progresses. In England it has already become the principal question. Whatever, therefore, can throw light upon it, is valuable. It is particularly in this respect, that we have noticed the letters from a travelling correspondent in England to the Pottsville Journal—letters of unusual interest, and well worth the subscription price of that Journal to all interested in coal mining. From a recent one we take the subjoined statement relative to the ventilation of a mine in Lancashire.

I have mentioned before that two steam engines of forty horses each, and supplied with steam from large underground boilers, were located near the bottom of the shafts, for the purpose of winding up the trains of loaded wagons from the lower works, along the steep road to the level of the shaft. The waste steam from these (high pressure) engines is made to assist in the process of ventilation, being allowed exit at the upcast or hot air shaft; and of course the heat of the two boilers 40 feet long aids materially the same object. In the 'cabins' or underground offices, barometers and thermometers are hung as safety-checks against imperfect ventilation—a fall of one inch in the barometer by increasing the bulk occupied by a given quantity of air, makes a difference of between three and four per cent. in the *value* of the air

circulating through the workings, and in addition to this diminution in the breathable quantity of the air, a freer discharge of fire damp simultaneously ensues from every part of the strata, and if goaves or other accumulations of fire damp exist in the mines, the gas which they contain becomes expended in the same ratio—that is between 8 and 4 per cent. is poured into the workings—of course with increased risk of danger. In the thermometer, a variation of only 10° makes a diminution of 2 per cent. in the virtual quantity of air transmitted through the workings; the velocity continuing the same, as in the course of one day, changes are often experienced of 10, 15 and 20°, the increased liability to accidents is again evident. By the frequent inspection of both instruments the amount of fuel fed to the furnaces is regulated, and thus their services to the miner in extensive underground workings are invaluable. The shaft arrangements by which the enormous quantity of five and six hundred tons of the fuel are delivered at the surface daily, are most perfect in "Cannel mines." The ascending and descending cages are two-storied, so that double rows of cars laden to the amount of 2,400 lbs. are wheeled upon the two floors in almost an instant, at the same time that the two layers of emptied cars are wheeled on to the other cage at the top—a signal is given by the engineer above; steam enters the cylinder, the windlass begins to revolve, and the two cages respectively ascend and descend at the rate of 900 feet per minute, and arrive in just 40 seconds, the one at the top, to be as quietly unloaded as loaded below, the other at the bottom, to receive in turn its tiers of coal cars for the transportation to regions of daylight. The celerity with which all this is effected is noticeable. In fact, this velocity of 900 feet per minute being a little quicker than the velocity of the air in the shafts, must either assist or retard the current according to its direction, and the influence of the passage of the cages up and down, is thus found to be decidedly an item in the calculation of the quantity of air forced through the mine for purposes of ventilation. In some experiments made to determine the extent of this influence in the adjoining "Arley mine," it was proven that when the cage was ascending the downcast shaft, consequently in a direction opposing the current, the number of cubit feet of air circulating through the mine per minute was only 85,625 cubit feet; while, when the conditions were reversed, and the cage was descending the same shaft, the amount exceeded 64,000 cubit feet; the average of the two being less by 9,000 feet per minute than when the cages were stationary. The importance of not neglecting this item when planning ventilating furnaces for supplying an extensive mine with the air, is obvious.

WIRE ROPES.

A correspondent of the Pottsville Journal, in describing operations at Mine Hill, presents the following facts respecting the use of Wire Ropes.

The wire rope here is unnecessarily large, and the drums, or pullies, are ridiculously small. We need no logic to prove the absurdity of attempting to wind so *large* a rope over so *small* a drum; it would be impossible to wind a bar of iron, from an inch and a half to two inches in diameter, round a six or even a nine feet pulley, very often, without breaking it. Wherever wire ropes have been used successfully, they have been of the smaller sizes and on large drums. A flat wire rope, composed of strands not over half an inch in diameter, would work on the same pullies as those which are now in use; but a round rope, large enough to draw six or ten cars up those planes, must wind over a drum not less than fifteen feet in diameter, for such are the lessons that experience has taught us in other places, and such we would suppose to be correct, from the nature of those ropes and the mode of working them.

We understand that the managers are going to place locomotives on the planes, which we have no doubt will work well, and be a decided improvement on the present mode of using the *large round* wire ropes; but the first principle,

when brought to perfection, is preferable to all others for doing a large business at a small cost.

The planes start with a gradual elevation from the bottom, and run nearly half way up before they become over 12°; therefore, an engine starting up with a loaded train at one end of the rope, and at the same time one at the other end starting down with an empty train, would work effectually. In starting up the plane the locomotive would be able to draw *more* than her own weight from the bottom, and would be able to sustain herself on the heaviest part of the plane; while the locomotive which goes down at the same time gives both her weight and strength entirely to the up train; which as it approaches the top, would not only have the weight of the down train, including the weight and power of the locomotive, but also the weight of the rope as a counter balance.

Yet there would be a serious difficulty in finding a rope—that is, a round one—which would be steady enough to bear the weight of such an immense load, and at the same time to wind around a pulley only ten feet in diameter, which is all that can be obtained without widening the tracks.

The Delaware & Hudson Canal Company tried large wire ropes on their planes at Carbondale some years ago, but they only lasted a few months; since, they have been using ropes less than an inch in diameter, and find them to work well.

PRIZE ESSAY ON VENTILATION.

The following sums have been subscribed towards premiums for improved ventilation in the Cornish mines. Royal Cornwall Polytechnic Society, 50*l*; Rev. Canon Rogers, 10*l*; Rev. H. Molesworth, St Aubyn, 5*l*.; Augustus Smith, Esq. 5*l*.; C. F. Giesler, Esq. 5*l*.; Hon. A. M. Agar, 10*l*.; T. J. Agar Robarts, Esq., 5*l*.: the Polytechnic Society offers premiums for competition, in the hope of directing a larger portion of public attention to the importance of improving the ventilation of the Cornish mines. Tables, showing the comparative longevity of the Cornish miner, and papers connected with this subject, which have been printed in the annual reports of the society, show the great sacrifice of health, of strength, and of life which at present occur, and indicate as one of the chief causes of these evils working in an atmosphere which is stagnant, impregnated with deleterious gases and exhalations, and deficient in that gas which is most essential to the preservation of life. It is conceived that new machines are not so much required as the application of principles already well known, and the introduction into common use of those mechanichal aids which are allowed to be effective: the larger portion of the funds at the disposal of the society has, therefore, been appropriated to encourage ventilation itself rather than the discovery of new means for effecting this purpose. Of the three kinds of machines now employed,—the fan, the reciprocating air-pump in various forms, and what may be termed the rotatory air-pump (an application of the principle of some of the rotatory engines)—it is believed that the last is not much known in Cornwall, though, from its requiring only a slow motion, it appears well adapted to the ventilation of metallic mines. Competition is not confined to members or residents in Cornwall.—*West Briton.*

SHAFTS IN COLLIERIES.

Coal Mines.—The shafts of the Newcastle coal field are often very deep. The deepest perpendicular coal mine shaft in the world is Pemberton's Pit, near Sunderland. It is 1,590 feet clear depth, or nearly equal to the monument of London when piled eight times upon itself. The cost of sinking this shaft was almost 100,000*l*., owing to the great difficulties met with in the enterprise. The most costly shafts are those which pass through sands full of springs of water, all of which must be "stopped back," and pumped out of the mine. Such shafts are lined with brick or stone, and sometimes with iron casing of

the most expensive character. The mere lining, or "tubbing," of the shafts, will cost from 60*l.* to 70*l.* per fathom (six feet). A shaft is not considered dear at an outlay of 10,000*l.* in difficult cases. The most expensive coal winning in the world, perhaps, was that of the Murton Pits, at South Hetton, near Durham, and which, owing to the peculiar obstacles encountered, was not completed for a sum less than 300,000*l.*! Few persons have any idea of the powerful springs of water cut in such sinkings. They are expressively named "feeders," and of such feeders three were cut in the Hetton Colliery, which supplied respectively 2000, 1000, and 1600 gallons of water per minute, Hebburn Colliery supplied 3000 gallons of water per minute. But the most abundant springs of water were cut in the Murton sinking, above mentioned, where, according to a fair calculation, no less a quantity than 8000 gallons of water per minute issued from depths of 70 to 80 fms.! At this colliery steam power to the extent of 570 horses was constantly employed in effecting the discharge of water and extraction of coal! This enterprise was carried on about nine miles from Durham, in a wild country.—*Wolverhampton Chronicle.*

COAL DEPOSITS IN SOUTHERN ILLINOIS.

We have already frequently referred to the coal deposits in the southern part of the State, but a recent conversation with Dr. Norwood, the State Geologist, convinced us that we had yet something to learn upon the subject. Until the present year he has not felt himself at liberty to anticipate his report by a communication of the results of his researches to private persons, Gov. French having enjoined him to silence; but the interdict is now removed, and he very freely and courteously answers all proper inquiries connected with the geology of the State. In the conversation referred to, Mr. Norwood spoke particularly of the coal beds in Williamson and Jackson Counties, lying near the Central Railroad, some of which are now being worked to a considerable extent. In the former county, the coal strata are numerous, and taken together, constitute seventy-five feet in thickness of solid coal, the largest seam being nine feet thick. This seam is now being worked, and furnished coal of an excellent quality. In Jackson County there is a seam of equal thickness, though it can hardly be called a single seam, since a thin layer of slate is interposed through its centre. Dr. Norwood speaks with great confidence of the superior quality of the coal generally in southern Illinois, and says there is none better west of the mountains.—*Chicago Press.*

ADVICE AND PRACTICAL HINTS TO UNDERGROUND COLLIERY MANAGERS.

Many of you may have commenced your career of labor in the Pit at an early age, and your opportunities for receiving instruction may have been few; yet by application and diligence you may have raised yourselves above your fellow-laborers, and been selected for your intelligence by your employers, to watch over their interests in the management of the mine. Be persevering in your endeavors to add to your stock of knowledge, and thereby improve your general intelligence. Read practical and scientific publications which treat upon subjects connected with your employment; and, in selecting such works, endeavor to obtain the advice of a person who is able to judge of their merits.

That there are many persons who object to the idea of scientific knowledge being applied to aid the operations of the miner, notwithstanding that it has already done much for the advancement of mining, is simply to be deplored.

An eminent scientific man some years ago visited the Collieries in the North of England, with the object of ascertaining whether something could not be invented to secure the light which the miner used, from exploding the gas met with in mines. The result of this gentleman's visit, and subsequent investigations into the subject, was the invention of the "Davy or Safety

Lamp," so well known to miners. Another eminent scientific man, after a visit to coal mines, first made known the principle of ventilation by means of the Furnace.

Practical men, combining scientific with practical knowledge, may yet accomplish greater improvements in mining, and lay down more effectual plans for protecting the lives of the employed, than have hitherto been brought to light. Many of the most eminent Engineers of the present day commenced their career in humble circumstances, and have by industry and perseverance raised themselves from the position of workmen to the high standing they have now attained.

Be temperate, consistent in your conduct, punctual in the discharge of your duties, and both by example and precept, encourage the men under your care to do the same, always bearing in mind that the workmen under your authority will, in most respects, conform their conduct to yours. Mildness, firmness, and decision, will insure obedience to orders or instructions that you may give, rather than boisterous and indecisive conduct. In giving instructions about work, forbear mixing them up with foolish remarks, and speak in such a way that the men may see that you have your employers' interest at heart; and when you have issued your orders, never allow the men to slight or neglect them.

It is the practice of some Underground Managers, when orders have to be given to the men, to send some subordinate person to issue such orders, although it may be important that the Underground Managers should attend personally to this part of their duty. It not unfrequently happens that an unwillingness to undertake the whole labor attendant upon their duties occasions the adoption of this plan. Men actuated by such feelings are not worthy of their office: whatever duties belong to your office faithfully discharge. If you send instructions through another, he may have an imperfect conception of your ideas, and may thus give such instructions very inaccurately: in addition to this, workmen, in many cases, slight the orders of a subordinate. The consequence of such neglect may be, that that which ought to have been well done may only be imperfectly executed, and may soon require to be done again, at a greater expenditure than the first cost. I have known several fatal accidents arise through Underground Managers delegating their duties to others.

When work is required to be done connected with the mine, you should not neglect to inspect the place, previously to the work being commenced, and although you may afterwards learn from report that the work is progressing well, you should not rest satisfied with the report, but see and judge for yourself whether it be properly executed. Workmen very soon perceive when an Underground Manager is easy and indifferent in the execution of his duty, and soon imbibe the same feeling of indifference, neglecting his orders in his absence. Thus, instead of having men aiding him to carry on the work as it ought to be carried on, and in preserving good order and discipline in the mine, the contrary state of things exists, and the mine is continually in a state of disorder.

Acquaint yourself with the workings of your mine, and endeavor to fix them in the mind, that every part may be so familiar to you as to render it unnecessary on all occasions to refer to a plan. This is a matter of great importance, and it is one that, if daily in the mine, you may soon acquire; such a knowledge will enable you to see what provisions may be necessary for the daily progress of the workings, and also for the carrying out effectively a good system of ventilation; it will further enable you to see whether any alterations that you may make in the mine will add to its safety or otherwise, besides enabling you more easily to discover causes of danger, and to ascertain in what way remedies should be applied. Without this knowledge of your workings, you will only discharge the duties of Underground Manager very imperfectly; you may have a Plan to refer to, but a knowledge of the workings, derived from reference to a Plan, is not to be compared with that

intimate knowledge, which is gained by making your workings the object of daily thought and reflection.

Should you occupy a place under a Master or Viewer, who conducts the mine under good regulations, and an able system of management, it is, notwithstanding, necessary that you should have a knowledge of your workings, to enable you to carry into effect his instructions, and to exercise a wholesome supervision over the operations of the mine.

You should also possess a knowledge of dialling, so that you may lay out your workings systematically, and drive them with regularity.

The utmost attention should be paid to those arrangements of the mine, upon which the health and lives of your men depend, and the nature of the accidents, to which the mine is most liable, should be ascertained, in order that steps may be taken to prevent their recurrence.

When working near, or towards, old workings, drive exploring drifts, and keep borings in advance of the face of the drifts, so as to prevent the sudden outbursts into the mine of water or gas which may have accumulated in them. Use the safety lamp; and, if practicable, send the air, which has ventilated these drifts, to the up-cast shaft without passing the workmen, or going along any travelling-road in the mine, or being brought into contact with the furnace fire.

If your mine has any fire damp in it, never al'ow inclined or level workings which end in the solid, to remain without ventilation, as gas will accumulate in such places, which, being open parts of the mine, become liable to explosions. If you have such places unventilated in your mine, and have occasion to go into them, use a safety lamp, and never follow the practice which some pursue, of leaving their candle at the bottom end, and going in without light, because the movement of the body may force out the gas, which will probably explode at the light. Your best course, however, is to ventilate such places. Unventilated places driven to the deep will have a natural drainage of fire damp, but upon which you must not depend to the neglect of the ventilation: if the fire damp drains from them, black or choke damp may accumulate there.

When you are working up to, or along the side of, troubles, dykes, or faults, keep your ventilation up to the face of such places, and use the safety lamp: fire damp is met with in great quantities in such parts of the mine, and, in the vicinity of these dislocations are found, in deep mines, cavities filled with compressed gas. If it is dangerous to work any part of your mine with naked lights, lose no time in supplying the men with safety lamps, which should only be employed under strict regulations.

Never descend unventilated old shafts, without first ascertaining their state with a safety lamp. Choke damp or carbonic acid gas, will accumulate in them, and many accidents have happened through men imprudently descending such shafts. A few shovelsful of lime, slackened to powder, thrown into the shaft, will clear it of choke damp, a remedy I have adopted on several occasions with the desired effect. The lime has a strong affinity for the choke damp or carbonic acid gas, and readily absorbs it.

You will be aware that gas or fire damp, and black or choke damp, accumulate in the goaves or those parts of the mine where the coal is all got, also in crevices of the mine, and in unventilated parts of the workings. You will doubtless have observed more gas in your workings at one time than another, which gas has come from the goaves and other parts of the mine where it has accumulated; and also that blowers, which at one time give out gas, will, at another time, draw in air. A change in the weight or density of the atmosphere is the cause of this. When a change takes place from a less to a more dense atmosphere, the gas will be forced back into the goaves, and blowers will draw in air. When a reduction of the density takes place, the gas in the goaves expands, and is then liberated in considerable quantities into the workings, and the blowers also give off gas freely. In the absence of instruments to indicate changes of pressure in the atmosphere, it would be

desirable that you should observe the direction of the wind, as changes in the wind's course are accompanied by changes in the pressure of the atmosphere. North-west, north, and north-east winds may be considered favorable, as the atmosphere is generally of greater density, and gas then accumulates in the goaves and crevices of the mine. As the wind passes southerly from north-west and southerly from north-east, the density of the atmosphere decreases, and south-west, south, and south-east winds may be considered unfavorable, and gas is then liberated from the goaves and other parts of the mine. Changeable and high winds act unfavorably to the safety of mines, by impeding the ventilation.

In order to observe the course of the wind, fix the points of the compass in a conspicuous place on the colliery, with a movable vane, and it will be advantageous to have it so arranged that you may see the course both by day and night. This you can effect by continuing the spindle of the vane down into a cabin, or other convenient place, and by erecting underneath a board having the points of the compass described upon it, and properly adjusted. When you observe unfavorable changes take place, the ventilation should be increased, and if the return air is highly charged with gas, it should be sent up the up-cast shaft without being brought into contact with the furnace; but in a well ventilated mine this will be unnecessary. If your mine is ventilated with the air passing through it in a single current, you should withdraw your men until it is safe.

A reduction in the pressure of the atmosphere not only increases the danger in the mine, by liberating, as has been before stated, bodies of gas from the goaves, but renders greater the liability to falls from the roof. A reduction of this pressure will operate in the same way as a removal of support will do from the roof of the mine, consequently the tendency of the roof to fall will be much greater when the pressure of the atmosphere is diminished.

The density or pressure of the atmosphere may be reduced by other causes, independently of any change of the wind; hence the necessity for observations by proper instruments.

The use of scientific instruments, and their careful application, will give notice of those atmospheric changes which cause bodies of gas to be liberated from the goaves and crevices of mines. The Barometer and Thermometer are both valuable instruments in a colliery, the one, as before explained, indicating changes in the pressure of the atmosphere, and the other changes in the temperature. The Anemometer will furnish a tolerably correct idea of the quantity of air passing through any part of the mine. Having fully noticed the use of these instruments in a previous chapter, I need not enlarge upon their utility here.

The operation of undermining coal preparatory to blasting, or wedging, it from the bed, has various local terms, such as *kirving*, *bearing*, *holing*, &c., but but although the two last have been used in various parts of this Work, I propose here to adhere to the term *undermining*. Some men cut away a height of from 18 to 20 inches at the face, in order to undermine 36 inches; these men generally begin the operation on their feet, and from this position they strike the seam at the height of from 18 to 20 inches from the floor, and generally undermine nearly 2 feet before changing to a sitting posture in order to finish the undermining; in a place 4 yards wide, these men cut to waste or to small about a ton of the best part of the seam, in undermining a yard forward; other men begin the operation in a sitting posture and strike the coal low, and will undermine from 30 to 33 inches, and only cut away a height of 8 or 9 inches at the face. These men will send half a ton or thereabouts of round coal more, from each head or yard forward, than the other men who undermine high. It is true that the man, who stands when he begins to undermine, can give a heavier blow with the pick, because greater force is communicated by the swing or momentum of his body, than can be obtained in a sitting posture, the force being produced in the last posture by muscular exertion alone.

If pit men would only consider their own interest, they would see that

the saving of labor to the man who undermines low is considerable, and that it would pay them well to adopt the practice; but in many cases touching their welfare, they are apt to evince a great want of reflection. In addition to economizing their labor, they would send more large coal out, for which a greater price is paid than for small or slack, and would earn from two to three shillings per week more on their coal, with less labor than the high underminer would have to bestow for the same area of mine excavated. If the coal is sent out without separation or dressing, and the same price be paid for large as small, you should have regulations to compel the men to undermine a fixed length, and only cut away a given height, say 8 or 9 inches for 33 inches undermined, and you should allow such of the men, as adhere to the dimensions you give, a small additional price for getting the coal, and should inflict a fine on those who exceed these proportions. There are many men who will confine themselves to these proportions; it is not, however, the strongest or the most powerful who will do so, but the expert and skilful workman. What one man can perform by his skill as a laborer, others can also be trained to do. In addition to making the men undermine low, you should compel them to undermine a proper length, so as to give the coal a better chance of being either wedged down, or blasted with powder in a mass. Many men are too idle to undermine a proper distance, and get their coal in short heads, seldom sending any large coal out: such men will probably be found amongst your young men, whose work should be diligently inspected.

To be continued.

IRON AND ZINC.

PRODUCTION OF STEEL.

In contrasting the steel manufacture of England with that of America and the Continent of Europe, I propose first to form an estimate of the weight of steel manufactured in each country, and its value, as an article of commerce; secondly, to show that England produces a greater weight of steel than the whole of the Continent of Europe and America; and also, by a comparison of the degree of perfection attained in each country, prove that whilst England produces a greater weight of steel, she also eminently exceeds other countries in her knowledge of this branch of manufacture.

The following Table shows the production of steel in France at different periods.

Year.	Raw steel.	Converted steel.	Total.
1826	3,257	1,500	4,757
1835	2,949	3,308	6,275
1840	3,546	3,859	7,405
1846	4,408	8,546	12,954

The manufacture of steel in France is considerable. They produce natural steel from the white iron of Dauphiny, and the metal produced from the spathose ores, which latter they import. The manufacture of converted and cast-steel has, during the past ten years, become important. The principal works are situated at St. Etienne, at which Swedish iron is mostly used, as at Sheffield.

Of the above, it must be noticed that the raw material is not the manufacture of the country, but a large portion is imported from Sweden; yet the table shows the weight of steel produced annually in this country. In 1846, the produce is estimated at 12,954 tons, of which 4,407 was raw or natural steel, and 8,546 converted steel.

There is no return of refined steel; but, as it is manufactured from the raw steel, it does not affect the statistical account. Cast steel being only made by two or three houses in France, the weight is not to be exactly obtained. The raw steel is higher in France than other countries, as it is protected by the import duties. I estimate it at $125 per ton. The weight of cast-steel I estimate in round numbers at 2,000 tons, which I value at $300 per ton, on account also of the protective duty. The iron for this production is imported.

The value of the steel product in France is—

12,954 tons natural and converted steel, at $125 per ton	$1,619,250
2,000 tons cast-steel, at 60*l.* per ton	600,000
14,954 tons	$2,219,250

In the Prussian dominions the major part of the steel produced is manufactured in Westphalia, around Remscheid, Lohngen, and Hagen. A portion is made in Silesia, Thuringia, and the Brandenburg district, in which there exist several converting furnaces.

The produce of the kingdom is as follows:—

Year.	Raw steel.	Refined steel.	Cast steel
1837	103,988	42,472	682
1840	97,930	68,602	686
1845	109,427	70,480	1,750
1850	107,674	68,879	17,645

These weights are in Prussian zentners (112 pounds).

In this table the converted steel is included in the weight of raw steel, from which material both the refined and cast-steel is produced. The number of furnaces employed to produce this steel are—143 charcoal fires, or refineries for raw steel; 105 furnaces for refining raw steel, 7 converting furnaces; 58 melting holes, or furnaces. In 1850 the Brandenburg district produced 3,160 zentners of converted steel.

The refined steel is largely used in the manufacture of the country; a further quantity is exported to the United States of America, to France, and Spain. The raw steel is used for common purposes. The cast-steel is principally made into railway springs and axles. The refined steel is of course manufactured from the raw steel.

In estimating the value of the whole produce, I deduct the waste of metal which arises from the refining process, so as to obtain the net remainder of raw steel; this waste I estimate at 15 per cent. upon the weight, produced in 1850, 68,379 cwts.: this will consume 78,634 cwts. Also cast steel is made both from raw steel and also converted.

Of the 17,645 cwts. manufactured, I estimate 10,000 cwts. as produced from raw steel, and 7645 from converted steel. 88,634 cwts. of raw steel is therefore consumed in the manufacture of refined steel and cast-steel, leaving 19,040 cwts. for common uses, or exportation.

I estimate the whole of these products as follows:—

68,879 cwts. or	3419 tons refined steel, at $100 per 1000 lbs. Prussian, or 30*l*	£112,570
17,655 cwts. or	882 tons of cast-steel, at $225 or 45*l.* per ton	89,690
19,040 cwts. or	952 tons of raw steel, at $56 per 1000 lbs. Prussian, or 19*l.* 10s.	18,564
	5253 tons.	Amount, $854,120 or £170,825

The weight of pig-iron consumed in Austria in 1847 was 368,000 cwts., equal to about 10 per cent. of the whole product of the blast furnaces of that country, including Hungary. This metal produced 287,300 cwts. of raw steel, of which 80,000 to 90,000 cwts., or 4500 tons, were consumed in the country in the form of steel, more or less refined, for the manufacture of sythes, files, and tools, besides the raw and common steel used for agricultural implements and the like.

The exportation in five years, from 1843 to 1847, was equal to 87,120 cwts., or 4356 tons, shipped from Trieste to the Levant, Mexico and South America.

The product of converted steel in 1848 was 210 tons, obtained chiefly from the melting of raw steel.

From the above statement the product of refined steel is 8856 tons, and 15 per cent. for waste in producing it from raw steel; and I find it requires 10,185 tons to produce it, leaving 4181 tons of raw steel for common purposes, named above.

I estimate the whole produce of Austria as follows:—

4,500 tons refined steel, for manufacturing in the country, at 30*l*. per ton......	£135,000
4,856 tons steel, exported, all sizes, averaged at 24*l*. per ton..................	104,544
4,181 tons raw steel, used for common purposes, at 19*l* 10s. per ton...........	81,529
13,037 tons	Amount $1,605,850 or £321,073

Sweden produces both keg and steel in faggots, which is chiefly shipped to the East Indies. The demand is very variable for this steel, and whilst at one time a considerable quantity is produced if the demand is brisk, at another their forges produce iron, which they can at all times either sell or send to the general depot at Stockholm.

Denmark, Holland, Spain, Portugal, Sardinia, and Italy, produce no stee of importance.

In the United States of America raw or natural steel is not produced; the only kind at present manufactured is converted steel produced from the Russian and Swedish irons, so largely imported by them. In a country which is advancing so rapidly, it is impossible to form any distinct estimate of the weight manufactured, but from my personal knowledge of the extent of it, I consider that 10,000 tons is a large estimate. Several attempts have been made to produce cast-steel in New Jersey and Pittsburg, but hitherto without success.

The American blister steel is quoted at 5 cents per lb., or $102 per ton, at 8 per cent. exchange is equal to about 21*l*. 5s. per ton; on 10,000 tons this would represent a value of 212,500*l*.

The manufacture of steel in England is chiefly confined to Sheffield, although it is also made at Newcastle and Staffordshire. I have already shown, in the early part of this essay, that the importation of Swedish iron, combined with that furnished from English materials, amounts to from 40,000 to 50,000 tons per annum; of course this weight represents the quantity of steel manufactured of every description.

Mr. Scrivenor estimates the number of furnaces in Sheffield and its neighborhood as follows:—

Year.	Converting Furnaces.	Cast-steel Furnaces or Holes.
1835	56	554
1842	97	774
1846	105	974
1853	160	1495

Now, a converting furnace will produce 300 tons of steel per annum, but if I estimate each to produce 250 tons, 160 converting furnaces would represent a make of 40,000 tons of steel a year in Sheffield alone. Again, he says there are 1495 melting holes, each furnace of 16 holes will melt 200 tons; this shows a product annually of 29,900 tons, but as such furnaces may not all be in continual work, from various causes, I have estimated the quantity of Cast-steel manufactured in Sheffield at 23,000 tons. The weight of coach-spring steel I have estimated at 10,000 tons, leaving a remainder of 7,000 tons of bar for the manufacture of German faggot, single and double shear-steel.

I estimate the weight and value of the steel made in England as follows:

23,000 tons of cast-steel, all qualities, at 45*l*. per ton	£1,035,000
7,000 tons bar steel, including German faggot, single and double shear steel, average 35*l*. per ton............................	245,000
10,000 tons coach spring steel, 19*l*. per ton......................	190,000
40,000 tons.	$7,250,000 or £1,410,000

IRON ORE OF LAKE SUPERIOR.

Among the fruits, from the discovery of the Lake Superior mines, is the erection of several furnaces for the smelting of the ores. One with a capital of $100,000 is in operation at Detroit, for copper. One at Cleveland, two at Pittsburg, one in Connecticut, one at Boston, and one in Philadelphia. Copper ore is also shipped to England. The investments already in these establishments is $1,500,000.

The iron ore is now a matter of great attraction. Blast-furnaces and rolling mills are at work on Lake Superior, This great richness of the raw material is such that thousands of tons are sent to Pittsburg. It is taken from the iron mountain, lying near the track of Ely's railroad.

The Eureka Company have purchased 1,000 acres of land, about ten miles below Detroit on the river, and started an iron village. It is called Wynandotte. Their design is to bring the ore thence and manufacture it into pig metal at Wynandotte, for which purpose they are now erecting a blast furnace, which calls for an investment of $20,000.

The Wynandotte Rolling Mills Company (capital $45,000) have established their works at this point, under the direction of Mr. Scoville, formerly of Utica Iron Works. The main building is now in process of completion, the tin roof being nearly on. The building stands one hundred and twenty feet square upon the ground, twenty-nine feet between joints, and sixty-five feet to the top of the cupola. The rolling works are propelled by a large steam engine taking its steam supply from five forty-feet steam boilers, set near the south-west corner, snd the trip-hammer is worked by a separate engine, which occupies the south-east corner.

The company have their machinery on the ground complete for the manufacture of bar, roll, band and other iron, and separate machinery for the making of railroad iron. They have a heavy contract for the re-manufacture of railroad iron with the Michigan Central Railroad Company, upon which they will commence as soon as their works are in operation.—*Rochester Democrat.*

SHEATHING ZINC.

Manufacture.

Zinc in sheets of a size and thickness suitable for sheathing vessels, is manufactured by the "Vieille Montagne" Company, at their extensive works, situate at Liege and other localities in Belgium, and at Bray, near the city of Rouen, in France.

The process of smelting this metal from the ore, and that of rolling it in sheets, have, like all other branches of industry, made great progress of late years. Zinc or spelter is now purer, and, after being rolled, more homogeneous and more malleable than it was formerly.

The Vieille Montagne zinc, previously known as *Mosselman's*, has, in an eminent degree, the qualities requisite for a good sheathing metal, viz., pureness, malleability, and durability.

Pureness.

Zinc cannot be obtained absolutely pure, except in the laboratory of the chemist. This metal, as it is offered to the trade, either in plates or in sheets, is more or less mixed with other substances. The Vieille Montagne zinc, owing to the superior quality of the ore, and the improvements in the smelting operation, is as free from such admixtures as can be required for all practical purposes. Repeated experiments have established the fact, that, of 1,000 parts, it contains:

Pure metal	995 parts.
Alloy	5 "
	1,000

The correctness of this statement may be ascertained by referring to the officers of the United States Mint, where the V. M. zinc is daily used for purifying precious metals.

Durability.

The Vieille Montagne have authentic testimonials, proving that several vessels sheathed with zinc, namely, the *Marie Louise* and *Noemi*, of Nantes; *Amitie*, of St. Malo; *Jean Bart*, of Grandville; *Joinville* and *Europe*, of Nantes, have been navigated with their original suit of zinc for eight, nine, and even twelve years. These, however, are exceptional examples, but the duration of a zinc suit in ordinary cases, may be safely estimated on an average at six years.

It is, of course, not intended here to guarantee that zinc in all cases will last six years; but, apart from the instances of long duration on record, the superiority of zinc in that respect is easily accounted for:

1. It is used in thicker sheets that either copper or yellow metal.
2. It does not oxidize or corrode as copper or brass by immersion in sea-water; on the contrary it is covered with an adhesive coat of peroxide, which becomes a permanent protection to the body of the metal.
3. When barnacles or sea-weeds that may have gathered upon it, fall, or are scraped off, the metal remains almost uninjured, while, with a copper or brass sheathing, they commonly leave it greatly thinned, eaten through, and crumbling off.
4. In regard to yellow or Mentz metal sheathing, immersion in sea water subjects it to a process of molecular decomposition, the effect of which is to deprive it of its tenacity and durability, rendering it so brittle that it can be crushed in the palm of the hand. This fact is unavoidable, viz., yellow metal being composed of about 60 parts of copper and 40 parts of zinc will, by contact with sea water, undergo a similar operation to that in a galvanic battery; that of depriving both metals of their affinity to each other.*

Economy.

The cost of copper in sheets, in relation to that of zinc, is generally as 3½ is to 1; if to this be added the well known fact that a suit of copper sheathing seldom lasts more than four years, the economy of using zinc will be self-evident.

The same conclusion applies to brass or yellow metal sheathing, the cost of which is only 1-6 less than that of copper, and which is acknowledged seldom to last more than three years.

The following comparison of the respective costs of the three different metals for sheathing a vessel of 400 tons, puts the point in question beyond the possibility of controversy. It will be conceded here for the sake of obviating objections, that *six* years is the period of duration common to all.

COPPER.	570 sheets of 24 oz.	4,000 lbs.			
	285 " 26 "	2,158 "			
	285 " 28 "	2,324 "			
	1,140	8,482 "	at 30 c. pr. lb.	$2,544 60	
	Brass nails	855 "	at 26 c. pr. lb.	222 30	
				$2,766 90	
	Interest 6 years, at 7 pr. c.			1,162 10	
				$3,929 00	
	Less value of old copper, 4,241 lbs. at 20 cts.			848 20	
	Net cost after 6 years			$3,080 80	$3080 80

* R. Armstrong, *London Artisan*, January, 1855.

YELLOW METAL.	570 sheets of 20 oz.	3,324 lbs.				
	285 " 22 "	1,829 "				
	285 " 24 "	1,995 "				
	1,140	7,148 "	at 26 c. pr. lb.	$1,858 48		
	Nails	855 "	at 26 c. pr. lb.	222 30		
				$2,080 78		
	Interest 6 years at 7 pr. c.			873 93		
				2,954 71		
	Less value of 3,574 lbs. old metal at 13 cts.			464 62		
	Net cost after 6 years			$2490 09	$2490 09	
ZINC.	570 sheets of 27 oz.	4,189 lbs.				
	285 " 30 "	2,494 "				
	285 " 32 "	2,660 "				
	1,140	9,343 "	at 9 c. pr. lb.	$840 87		
	Zinc nails	760 "	at 16 c. pr. lb.	121 60		
				$ 962 47		
	Interest 6 years, at 7 pr. c.			404 24		
				$1,366 71		
	Less 4,671 lbs. old metal at 3 cts.			140 13		
	Net cost after 6 years,			$1,226 58	$1,226 58	

Number of Vessels Sheathed with Zinc.

Want of space prevents the insertion here of the names of vessels sheathed with zinc, since its introduction, but a steady increase of its adoption, for that purpose, is evident from the French *Veritas*, or Lloyd's List, which contained, in 1850, the names of 1,400 vessels so sheathed on the continent; and the Vieille Montagne Company have records of nearly the same number since 1848 to the end of 1854, in the various ports of England and North America.

Directions.

Sheathing zinc is of the same size, viz., 14 by 48 inches, and is punched and nailed absolutely in the same manner, as copper or yellow metal.

Three gauges are commonly used—15 of 27 oz., 16 of 30 oz., and 17 of 32 oz.; the proper nails to use with this sheathing are the 1 1-8 and 1 1-4 inch wrought zinc nails, 200 to 220 to the pound.

The sheets are imported in cases of 550 pounds. Those of No. 15 gauge contain 80 sheets; 16—74 sheets; 17—65 sheets. Zinc nails are shipped in 1 cwt. kegs.

If the vessel to be sheathed is iron fastened, so much the better, as zinc preserves iron, while, on the contrary, copper destroys it by its injurious galvanic action.

If the vessel is copper or brass fastened, it is necessary to *isolate* as much as possible these fastenings, by first lining the hull with tarred felt or sheathing paper. The galvanic current that otherwise might exist between the two metals, is prevented by this lining.

It is well known that all metals are more or less rendered brittle by cold. When a vessel must be sheathed with zinc in frosty weather, the brittleness will be prevented by immersing the sheets and nails in warm water; this may appear a troublesome precaution, but its utility amply compensates for the trouble of keeping some water hot in the tar kettle.

Zinc Bolts for Fastening Vessels.

Zinc can be rolled in bars of all sizes, like copper and brass, and it was proposed a few years ago to use it instead of the old metals for fastening ves-

sels, showing at the same time that such substitution would be productive of a considerable saving in the construction of all kinds of ships.

This, however, being an entirely new application of zinc, it could not be expected that the suggestion would be immediately acted upon. The public must be convinced first that zinc bolts could be used with the same facility, and possessed the same strength as copper or brass bolts.

In order to leave no doubt on those points, the Vieille Montagne Company have caused experiments to be made during 1852, in ten French seaports, publicly, and in the presence, in each, of a great number of owners and masters of vessels, merchants, scientific men and government functionaries. All these experiments were entirely satisfactory, and proved that zinc bars have all the strength, tenacity and malleability desirable for ship fastenings. Minute records were made of the different trials, signed by the parties present, and were printed in pamphlet form, which may be seen at the general agency office of the Company.

Let us add that the successful application of zinc bolts for fastenings is now no longer a problematical vagary, but an established fact, there being at present afloat a ship of the British navy, the *Albion*, a two-decker, of 90 guns, *entirely zinc fastened.*

It is proper here emphatically to repeat the remark already made with regard to the action of sea water upon yellow or Muntz metal:

"In every case in my experience," says Armstrong, "where it has been necessary to have bolts of that metal removed, I have found them broken asunder, or so brittle that the slightest force was sufficient to break them. From the appearance of the metal, its nature seemed to be quite changed, rather resembling broken earthenware than brass."

Sea water has no such destroying influence on pure zinc bolts, and the sooner the use of such a treacherous material as Muntz metal is abandoned, and that of zinc substituted, the better, as a matter of economy and safety for ships.

Constructing Ships entirely of Zinc.

There could be no more difficulty in building the hull of a vessel of zinc than building it of iron; on the contrary, its possession of all other requisite properties being established, it is evident that the greater malleability of zinc would facilitate the shaping, boring and riveting of the plates.

The attempt has already been made, and the result has realized the most sanguine expectations of the parties interested. The square rigged schooner *Comte Lehon*, built of zinc, was launched, in 1854, from M. Guibert's dockyard, at Nantes, and made a first and successful voyage to Rio de Janeiro, whence she sailed for Marseilles, and is now a regular trader.

The zinc plates used in this instance are of No. 8 wire gauge (corresponding to No. 30 zinc gauge); they overlay each other one inch, and are riveted with wrought zinc rivets, 1 1-4 inch apart.

A zinc vessel, while it is hardly inferior in strength to one of iron, has over the latter many advantages:

1. It will cause no deviation of the compass.
2. The plates not being liable to corrode or rust, do not require painting.
3. In ordinary cases of collision, while iron would in all probability crack or break, causing a leakage in the vessel, zinc would yield and bend without endangering the safety of the vessel and hands, or interrupting her course.
4. In the event of stranding near shore, and in a position and under circumstances allowing salvage, the zinc hull might be cut or sawed in pieces, having a real value, while the iron hull would be abandoned as worthless.

QUARRIES AND CLAYS.

THE TALLADEGA MARBLE QUARRIES.

[For the Mining Magazine.]

At the present moment, when property in your county is about to be greatly enhanced by the conveniences consequent upon the proximity of a railroad, and when the utility and furtherance of the project may be dependent upon the existence of those resources, which it is intended to develope, a few remarks upon the marble quarries of Talladega county, can scarcely be unwelcome to those who take an interest in the mineral productions of your State. It is with this impression at least, that I beg to tender the following brief observations, since some time must necessarily elapse before the reports upon the geology of the State can be laid before the public.

Those quarries which were in operation, when I examined them, are Mr. Taylor's, Dr. Gant's, Mr. Nix's, and that of Messrs. Alex. Herd and Brothers. Unfortunately I have not at present my notes on Mr. Taylor's quarry with me, as the description of that, as well as of one of Dr. McKensie, has already been furnished in a previous report to Prof. Tuomey. The following remarks will therefore be confined to those of Mr. Nix and of Messrs. Herd & Bros. Mr. Tuomey having in a published report already described Dr. Gant's.

A few preliminary remarks on the general geology of the portion of the county alluded to, are necessary. The metamorphic rocks (i. e. the slates &c., in Hillibee, Randolph Co., Tallapoosa Co., and Coosa Co.), of Alabama, like all the rocks of the more northern Alleghanies and Blue Ridge, consists of vast parallel folds,—these mountain ranges being what German geologists term *falten-gebirge* (fold mountains,) in contradistinction to those in which an anticlinal axis is observable, and in which the dip, the inclination of the strata, is opposite in the two sides of the ridge, as well as to those in which the strata dip toward all points of the compass from one apex. This fact explains the phenomenon, observed throughout these eastern American mountains, that, with few, merely local exceptions only, the dip of all their constituting rocks is the same in direction, viz: S. E., varying only in the angle of inclination. These immense folds were the result of the combined agency of the gradual cooling of our sphere in ages past, and consequent contraction, and of great lateral pressure. The peculiar position (as will be seen hereafter), and the open works of the marble quarries necessarily afford admirable means for observing facts connected with this interesting peculiarity.

All who have paid any attention to the marble quarries of Talladega county must have been struck with the fact, that they seem to be confined to the immediate proximity of the metamorphic rocks, situated, as it were, in a band of marble, which separates the other limestones (for marble is a true limestone, differing only from the ordinary limestone in being of sufficient hardness to receive polish) from the metamorphic rocks. This may be owing to the metamorphic agencies, which converted the latter rocks to their present shape, having also exerted some influence upon the adjoining limestone.

In all the quarries named, with the exception only of that of Messrs. Herd, the marble immediately underlies the talcose slate, and in the instance, which forms the exception, a narrow stratum of sandstone and above this another of quartz rock are the only intervening beds.

A great variety is perceptible in the Talladega marble, both with regard to its intrinsic merits, and the thickness of its beds, a difference thus adapting the diverse marbles to distinct purposes, and making the one or the other more perfect, according to the uses to which it is applied.

The quarry of J. M. N. B. Nix, Esq. has, of the two of which I have proposed to speak, been in operation the longest. At his quarry a fine section

has been laid bare, showing the postion of the marble and that of the superincumbent talcose slate. The colors of his marble pass from blue to pure white, but the most abundant seems to be that in which the two colors alternate with varying intensity. I am indebted to Mr. Nix for the statistics of his works, with which he has had the kindness to furnish me, and, although they are only approximative, they may prove interesting to many of your readers. These works were commenced in 1850, and the apparent decrease in the number of hands after the first two years is owing to the fact, that during the years 1850 and 1851 his hands were chiefly occupied in stripping the soil and clay from above the marble, and in building. Hence, during those years, as well as the succeeding one, few hands were occupied at his dressing works.

Years.	Tons of Marble Quarried.	No. of hands employed in Quarrying.	No. of hands employed in dressing on the spot, and at Selma and Montgomery.
1850	. . 100	. . 20	 12
1851	. . 150	. . 20	 12
1852	. . 150	. . 10	 12
1853	. . 300	. . 20	 21
1854	. . 400	. . 20	 21
Total . .	1100		

At present the same number of hands, as last year, are employed. When, however, the railroad is completed, Mr. Nix informs me, that he proposes to increase his force to one hundred hands, of which one half at least will be negroes, as their labor and behavior is found to be preferable. A sixty-horse engine, besides the water-power, is employed in sawing the marble. This quarry is situated in the southern half of a section 36, township 20, range 4 east, and is nine miles from the proposed hundred-mile station on the railroad. During the several years, in which this marble has been in use, its qualities have been amply tested, and it will, consequently, be unnecessary to dwell further upon its characteristics.

The quarry of Messrs. Herd and Bros. in section 18, township 20, and range 5 east, and five miles from the hundred-mile station, has been but recently properly worked, though opened first in 1850, and should by no means be mistaken for the one so long operated in by Mr. George Herd, deceased, since the latter can in no point of true value compare with it. Its situation—a hill rising to perhaps fifty or sixty feet above the neighboring creek,—as well as the quality of the marble, has admirably adapted it to its present purposes. Not only is the beauty of this marble to be found in the purity of its coloring, but also in its peculiar liveliness. Indeed, I have not observed a single specimen at this locality, which presented that dead, plaster-of-Paris appearance, not unfrequently seen elsewhere. Though white, of varying nuances or shades, is the universal color of the beds hitherto exposed, those bluish cloudings so common in Italian marble, and which are often desired, from the relief they afford to the else universal, dazzling white—are not uncommon. In no instance have I observed the parallel streaks of a darker color, which give to some of the marbles in use the appearance of being weather-stained. This is not surprising, when we consider that these striæ are the result of minute, intercalated beds of talcose slate and that such impurifications are scarcely ever met with in this quarry. The only stratum of the kind observable, where the quarrying is at present carried on, is 8 feet 3 inches from the top of the marble, and none other has been met with beneath, although they have penetrated to a fully equal depth below it. The apparent

difference of a specimen of this marble, held by the side of a piece from Italy, was only to be noticed in the greater compactness or finer grain of the former. There is, however, another great want of similarity between the two. The Italian marble is not stratified, while all Alabama marble is. Owing to this great difference the latter is not adapted to statuary purposes, for of course it works easier on the bed, than on the edge. So great is this inequality in some instances that, as Mr. Nix informs me, a hand who can work ten feet in a day's drilling on the bed, can only accomplish two on the edge. All the latter work not effected by the blasting, is therefore left to the saws. At Messrs. Herd's quarry the difference between the bed and the edge is found to be so slight, that the common workman is scarcely able to detect it, although as a matter of course, the sculptor's chisel would soon make even this trifling difference apparent. It is nevertheless a circumstance, which will enhance the value of this marble for solid work, such as columns, obelisks, &c. The great hardness of this marble is another peculiarity, which it is necessary to mention. That this is the case is seen from the fact that, while other Talladega marbles enable a hand to drill as much as 200 inches in a day with ease, 90 to 100 inches seem to be the maximum at this quarry.

The rather minute description of Messrs. Herd's marble appears desirable, since their quarry has as yet furnished the market with but little of its rock. As the owners, aided by long experience in the business, are energetically prosecuting their operations, and are now about to place an engine of thirty-five horse power on the spot, it is to be hoped that before long my remark will no longer be true. A rough estimate would indicate that about 3000 cubic feet of the rock have, as yet, only been removed from that locality.

The price of the marbleis, I understand, on the spot, universally $2 per cubic foot, when rough; $10 per feet dressed plain; or 75 cents roughly sawed, per square foot of two inch slabs, though when dressed the price for the same is $2. We hope that the proprietors will continue to benefit themselves and their customers by a continuance of the energy they have hitherto exhibited.

Oscar M. Lieber.

SHELL-MARL IN MISSISSIPPI.

It has already been published in several papers of our State, that I have discovered on my geological tour through the south-eastern counties of the State of Mississippi, a very important and really inexhaustible deposit of Shell-Marl. The deposit is in the southern part of Clark county; I found it first on the plantation of Gen. W. B. Trotter, in a deep gully, with high and perpendicular bluffs, on Section 8, Township 10, Range 7 West, about 20 feet under the surface, cropping out in the gully. This really invaluable deposit of Marl, is evidently a member of the Tertiary (Eocene) Lime Formation which is so well developed in the south-eastern part of our State. This formation is similar to the Cretaceous formation of the Secondary period, of which it is most evidently a continuation. It consists:

1. Of a hard Carbonate of Lime, or white Limestone, in many localities eminently fit for burning Quick-Lime:
2. Of a soft Aluminous Carbonate of Lime, an inferior kind of Marl, and
3. Of a fine Green-Sand, full of tertiary shells and of a superior quality, generally better than our Green-Sands of the upper and lower Cretaceous formation of the Secondary period, and eminently fit for a Marl of Prairie and heavy clay soils.

The deposit of fine Marl, above mentioned, takes the place of the Green Sand of the tertiary Lime formation; it consists to a large extent of the detritus of shells and their former inmates, the decayed Mollusks. This bed of Green-Sand is not confined to Gen. Trotter's plantation, I found it also outcropping along the bluff of the Chickasawhay river. This bluff is in that locality (Sec. 8, Township 10, Range 7, West) very nearly 100 feet high; the

deposit of Marl appears for miles along the river, and forms its bed for more than one mile; it is in some places at least 50 feet thick. This deposit appears to dip from East to West, its strike is decidedly from North to South. At the first view of this deposit of Marl, I recognized its superior quality, and its great importance for a purely agricultural State as ours is; I declared it instantly the best Marl I ever had seen, but a rapid analysis to which I have, since my return to our University, submitted the specimens of Marl collected partly on Gen. Trotter's plantation, partly on the bluff of the Chickasawhay river, has by far exceeded my expectation.

According to this analysis the Marl contains in 100 parts:

Iron and soluble Alumina	8.000
Carbonate of Lime	82.954
Phosphate of Lime	8.852
Sulphate of Lime	3.648
Chloride of Magnesium	900
Potash and Ammonia	7.840
Insoluble Silica and Alumina	41.580
Hygroscopic water and loss	1.740
	100.000

(To be continued.)

MISCELLANIES.

PLATING METALS.

F. S. Thomas and Wm Tilley, of London, have obtained a patent for coating lead, iron, or other metals, with tin, nickel, or alumina. The following, from the London *Mechanic's Magazine*, is a description of the process, taken from the specification of the patentees.

"The first part of our process," says the inventors, "consists in a mode of preparing a solution of the metal with which the articles are to be coated or plated, for which purpose we proceed as follows:—For tin we dissolve metallic tin by nitro-muriatic acid, and then precipitate the tin by an alkali, or alkaline salt, preferably by the ferro-cyanide of potassium; we then mix sulphuric acid or muriatic acid with the precipitated oxide of tin, to which we add a portion of water; these we boil in an iron vessel with a small portion of ferro-cyanide of potassium, then filter the liquor, and the solution is completed.

Another mode of forming a solution of tin is as follows:—Having precipitated the oxide of tin, as above described, we add ferro-cyanide of potassium to the oxide and boil them; then set the solution aside to cool, and then filter the same; we then pass a stream of sulphuric acid gas through the solution.

For nickel, we dissolve nickel by nitro-muriatic acid, and precipitate the oxide by ferro-cyanide of potassium; we then wash the oxide and add thereto cyanide of potassium dissolved in distilled water: then boil the mixture, and when cool filter the same, which completes the solution of nickel.

For alumina, we dissolve alum in water; and add ammonia until it ceases to precipitate any more; we then wash the alumina, filter it, add thereto distilled water, boil the same with cyanide of potassium, filter when cold, and the solution of alumina is ready.

Having thus obtained either of the foregoing solutions, the articles to be covered or plated are suspended by copper or brass rods in a bath of the required solution, and attached to the zinc pole of a battery, to the positive pole of which is attached, in the case of a tin bath, a piece of platinum, or a pole of tin; in the case of a nickel bath, a bag containing oxide of nickel, or a pole of nickel; and in the case of a bath of alumina, a bag of alumina, or a pole of alumina, or a piece of platinum."

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... door to chemical manu- ... vitriol), and without sul- ... would cease to exist. By its aid we ... that the bare mention of them ... dyeing, soda-making, metal-refining, ... &c. are primarily indebted to this acid. ... could not be made without it, such as ... the chief ingredient of gunpowder, modern ... unavoidably without it. A people that does not ... stands beyond the pale of civilization, yet matches ... without sulphur; not because matches are dipped into melted ... they are "tipped" with the phosphoric composition which ... but because this very material could not be made without the in- ... of sulphur. In England we consume 60,000 tons of sulphur annually, ... imported to this country from the volcanic regions of Sicily. For ... reasons, the King of Naples has recently prohibited the export of ... any of the kingdoms now at war. Reckoning the value of sulphur ... ton, implies a loss of 300,000*l.*; a pretty liberal "peace offering" ... King of the two Sicilies! This loss of sulphur will be severely felt from the ... for a short time in England; but eventually it will be of great service, as we have as much brimstone in this country as commerce requires—a fact that will soon be made manifest by the demand for it; and when once it is seen that our own resources are sufficient, the King of Naples must never expect us to go to his shop any more. It was thus during the last war that we prevented the French people from eating Jamaica sugar—so they set to and made sugar from beet-root, and we have lost so much trade ever since.—SEPTIMUS PIESSE: in *Family Herald.*

THE SODA AND BRIMSTONE TRADES.

The exports of soda for the months of June, 1853, 1854, and 1855, were 71,703, 93,742, 106,473, cwts. amounting to the declared value, respectively, of 31,921*l.* 88,010*l.* and 37,890*l.* For the first six months of 1853-54-55, the quantities exported were 545,308, 534,333, and 460,932 cwts. of the values, respectively, of 238,108*l.* 230,964*l.* and 172,072*l.* The imports of brimstone for the same monthly periods were 29,283, 78,078, 143,769, cwts., and for the same six monthly periods 206,817, 619, 362, and 356,802 cwts. We are glad to learn that at last symptoms of improvement are exhibited in the soda trade on the Tyne. Manufacturers are now asking higher prices, and what is better still, are able to obtain them.—*Gateshead Observer, Eng.*

CALIFORNIA MINERALS.

The Citizen says: Recently in El Dorado county an immense bed of arsenical ore is said to have been discovered. Beautiful variegated marble has also been found in the same county, and in Yuba, a mine of genuine coal has been found, and preparations are now being made to work it. That silver exists in considerable quantities throughout the State is well known, and platinum has been found in various portions of it. The quicksilver mines of New Almaden are the richest in the world, and fine specimens of cinnabar have recently been found in Mariposa county, and doubtless exist in other portions of the State.

INFLUENCE OF BISMUTH UPON THE DUCTILITY OF COPPER.

M. Levol has shown that bismuth, even in very small quantities, exerts a very injurious action upon the ductility of copper. An alloy of pure copper, with 1-100th of its weight of bismuth, had a crystalline texture, and a well

marked gray tint, and was torn under the hammer. A second alloy, formed of pure copper, in the state of very fine wire, with 1-1000th of bismuth, had also a crystalline texture, and had but a very slight ductility. He was led to make these experiments by the analysis of some specimens of black copper from Australia, which presented unusual difficulties in the process of refining, and which he discovered, contained 0.144 per cent. of bismuth, and even when refined still contained 0.048 per cent., and was a very inferior quality. He directs attention to these results, as pointing out the necessity of looking for traces of bismuth in the copper of commerce, and thus avoiding many disagreeable results, which have frequently ensued from the employment of certain coppers; and which, he appears to think, are attributable in many instances to the presence of traces of bismuth.—*Bulletin de la Societe d'Encouragement.*

THE PRESTON SALT VALLEY.

The Preston Salt Valley is included in the Valley of the North Holston which is marked by an enormous fault or fracture of the rocky crust, which extends for a distance of not less than one hundred miles; but only about fifteen or sixteen miles of its north-eastern extremity are said to be characterized by the conditions essential to the accumulation of saline and gypseous ingredients. Gypsum is found at various points in these sixteen miles, lying in Washington and Smyth counties; but thus far, of all the basins in the line of the disruption in the original strata, the Preston Salt Valley is the only one where have been developed the salt deposits and salt water in sufficient quantity for commercial purposes, and there it would seem to be inexhaustible. Many fruitless attempts have been made in other basins to discover it. In one of these efforts a shaft six hundred feet was sunk without finding salt; but it penetrated plaster the entire depth, and the cost of the pit was nearly defrayed by the plaster excavated, it having proved a valuable gypsum, anhydrous, or free from water. These beds of gypsum are of course of unknown extent. They are known to cover a great surface, but their depth has not been ascertained. It is sufficient to know that they are inexhaustible. In the Preston Salt Valley the beds are immense, lying a few feet from the surface, and extending down it is not known how far.

This Valley of the North Holston, shut in by lofty sandstone mountains on the north-western and south-eastern sides, has a network of short crests and insulated knobs, deep ravines and winding valleys, that give to it a picturesque appearance. The extensive longitudinal fault having been intersected by a series of lateral disruptions, gave to the water by its alternate damming and breaking away, its great power, and drove it in winding currents, shaping the hills and "grooving out the ravines between them." The excavations along the valley at Saltville, show the violent agencies that have been at work. There you see compact masses of earth and finely pounded slate and stone, that have been subjected to a sliding and grinding process and pressure of great power. There, too, are fossil remains of animals belonging to the Mammoth species, many specimens of which are shown at the salt works. Imagine, as is the case, that these hills and hollows, enriched by the decomposed rocks of the locality, are clothed with luxuriant vegetation, and you may well conceive that the valley is beautiful beyond description. But the most interesting part of it is the Preston Salt Valley, of which Professor Henry D. Rodgers has given the following faithful description.

"In the middle of this chain of hills of the Holston Valley, lies, beautifully encircled by fertile indented slopes, and a chain of knobs and spurs, the small but remarkable Valley of the Salt Works and Gypsum quarries of the Preston and King estates. The bed of the Valley is an oval shaped plain, of rather more than 300 acres in extent, as smooth as a bowling green, but not as level, having a gentle uniform slope from its south-eastern to its north-western side, or towards the Holston river. From this rapid stream, it is separated by a

nearly straight range of variously shaped limestone knobs, between whose fertile sides descend ravines into the pent-in basin, which discharges its collected waters into the river through the deepest of these transverse passes. On the opposite or south eastern side, the plain is half engirt by a semi-circular sweep of mountain, or a crescent-like indentation in the flank of the bounding ridge. [Just on the outer edge of this semi-circle, stands the old mansion of the Preston family, where the Board of Trade et als. were most bountifully entertained.] The soil of the Valley is wet and peaty, and beneath it, to an enormous depth, there appears to be no solid rock, but a deposit of clay and earth embedding in places large bodies of rock salt and of gypsum, and saturated in its lower portions with highly concentrated brine."

Col. T. L. Preston, who owns all but the south-western end of the Valley, is the proprietor of adjacent lands, of great fertility, to the extent of about 6000 acres.

The salt wells.—These wells are owned by a number of persons. Col. Preston owns more than half of those worked, while there are other wells on his land, not now in use. Some four or more acres only of the King property, corners in upon the salt wells; but that is quite sufficient to afford the proprietors as much of the brine as could be desired. The pumping it up is a small part of the labor of manufacture—two pumps furnishing at present enough water for the whole evaporating power. It is easy to see how the proprietor of salt wells might find himself suddenly in the condition of the man in the Mexican army, who had his barrel of cider tapped at the opposite end, and a rival in the next tent to him selling it at half price! If the water happened to go a little beyond his line, his neighbor might bore into it, and in a saline respect be just as rich as he, though his land might be but a strip in comparison.

The general theory is, that the body of fossil salt, as well as the beds of gypsum, were deposits into the fissures of the fault from the adjacent saliferous and gypseous rocks, which were dissolved by water percolating through them after their disrupture and probable edgewise upheaval; or it may have been as Professor H. D. Rogers suggests, the action of jets of boiling water issuing copiously through the ragged chinks of the fractures. With such an agent, the dissolution would have been rapid, as the *geysers* or boiling waters of Iceland are known to bring up and deposit in quantities pure *silica*, a much harder substance than those dissolved in the Preston Valley.

Whatever be their origin there, these deposits are, and we trust their owners will make the most of them. The brine is reached about 200 feet from the surface. This brine is the strongest in the world, as well as the purest. Its usual proportion of Salt is about 23 per ct., eighteen gallons yielding one bushel of pure salt. The Syracuse salt wells only have a strength of 17 per ct.—the Kanawha rarely exceeding 10 per ct. It has none of the chlorides of calcium and magnesia, and when evaporated, not appreciable amount of *bittern*, an ingredient that produces a tendency to the absorption of moisture. Therefore put up in barrels, (the form in which it is transported,) this salt is exposed to the atmosphere without detriment. There is some gypsum in the water, but that becomes incrusted on the bottom of the kettles, and is thus separated from the salt.

The brine rises in the wells (which are four inches in diameter) to within 45 feet of the surface, from whence it is pumped by steam engines into the reservoirs. From these reservoirs it is conducted to the kettles in the evaporating houses by wooden pipes. One of these houses is two miles from the wells, immediately on the bank of the Holston. The others are at the wells. The evaporation is effected in kettles, beneath which are furnaces where heat is constantly kept up, from Monday morning to Saturday night. It is a beautiful process, the crystallization of the salt, which takes place on the surface, after which it falls to the bottom, and is scooped up almost as white as snow. After being left to drip awhile in split baskets over the kettles, it is thrown in bulk, whence it is put up in barrels. The salt is believed to be the purest

that is manufactured. The table salt is certainly the most beautiful we ever saw. As to the supply from the wells, there is no telling its extent. There has been no falling off in the flow of brine for a long series of years, and it is just as strong as when first discovered. Moreover, the existence of vast depths of rock salt being ascertained, the capacity of supply may be considered unlimited.

Wyndham Robertson, Esq., is the lessee of the Salt Works, as well as the proprietor of an interest in them. He pays an annual rent of $35,000. The annual produce of the works is a little over 300,000 bushels. The chief market is East Tennessee and upper Mississippi and Alabama. It is taken down the Holston in large flat boats, and along the Tennessee as far as Muscle Shoals, which is the end of the voyage. The boats can only float down the river, however, upon a rise of three feet at the landing. Last year there was no rise, and an immense stock accumulated on Mr. Robinson's hands, before he was enabled to float off his fleet. The price at Muscle Shoals has been latterly 75 cents per bushel; at the works 50 cents.

The wells can supply any demand; and it is likely that after the Railroad line though that country is completed the market for it will be increased. Mr. Robertson has commenced boring on his own land at the upper end of the Valley, for salt. He has bored 600 feet without finding any; but is determined to continue 600 feet further, when, if he has not succeeded before, he will abandon the enterprise.

Col. Preston and Mr. Robertson, each are working Plaster beds, and have Plaster mills near the Salt Works. Their operations can be extended in proportion to the demand.

A branch of the Virginia and the Tennessee Rail Road is to be constructed to the Salt Works six miles long. We passed along the embankment in our route to the Wells. A good portion of it is finished. It is confidently predicted, that Saltville, with its unlimited supplies of Salt and Gypsum, can load a train each way, east and west, every day of the year, if the demand will justify it!

Man is lost in admiration, in contemplating the wonderful characteristics of this basin. Its surface is incomparably beautiful, while the riches underneath the soil are inexhaustible. It is a source of wealth at once inappreciable. In its vast beds of Gypsum, that part of Virginia has a fertilizer through all time; and in the Salt of the Preston Valley, a commercial commodity, that will in all human probability be equally as enduring.—*Corresp. Richmond Despatch.*

OBITUARY.—NOTICE OF THE LATE JOHN GRAEM ELLERY.

By the death of John G. Ellery, science has lost one of its most energetic and indefatigable workers, who could ill be spared from his favorite field of investigation.

He died on 2d of June, 1855, at Gold Hill, Rowan Co., N. C., of one of those virulent attacks incident to the climate. He had been engaged there for some months in a Geological Survey, having direct reference to the value and most economical mode of working the gold, silver, and copper ore of that region, and was just about to return to New York, when he was prostrated by sickness.

Mr. Ellery was educated in part at Hamilton College, N. Y., and afterwards graduated at Amherst College, Mass. Having chosen the department of geology and mineralogy as the great study of his life, he turned his attention after leaving college, to the study of chemistry, as the groundwork of his preparation for the special object of his pursuit. His studies were completed at the Royal Academy of Mines, in Freiberg, Saxony, where in an unusually short time, he not only familiarized himself with the principles of mineralogy and geology, but also mastered the practical departments of Mining and Metallurgy. He was well versed in the department of analytical chemistry, and under Plattner became especially proficient in the use of the blowpipe. It was his ambition to fit himself for developing the mineral resources of his own

country, and to this end his efforts were unwearied. His devotion to science as well as his true manliness of character, won for him there, as well as here, the highest respect and confidence of his teachers. His career since his return from Europe, though brief, had been full of promise. He had already accumulated a fund of information, with regard to the mineral resources of North Carolina, that would soon have been made available to the public, had he not fallen thus prematurely. All who knew him merely as a man of science, feel most deeply the loss to themselves and to the world: but besides these, a wide circle of friends, who appreciated not only his scientific qualifications, but his many excellencies of character, his integrity of purpose, his native kindness of heart, his self-sacrificing spirit, feel more deeply than words can express the affliction that has come upon them.

A NEW DIAMOND FROM BRAZIL.

Mr. Halphem has recently received from Brazil, a diamond, very remarkable both for its size and for the perfection of its crystalline form. As soon as it appeared in commerce, it fixed the attention of lapidaries, who, to distinguish it from known diamonds, have called it the *Star of the South.*

The *Star of the South* weighs 42-275 grms., corresponding in the language of lapidaries, to 254½ carats; by cutting, this diamond will lose nearly one-half of its weight, and will then be reduced to about 127 carats.

This weight will still place it among the four or five most precions diamonds known.

The Ko-hi-noor weighs from 120 to 122 carats.

The *Star of the South* will, in the opinion of lapidaries accustomed to judge of the water of a diamond while it is yet rough, be perfectly limpid, and will have the peculiar lustre which gives to diamonds so high a value.

The general form of the *Star of the South* is a rhomboidal dodecahedron, bevelled very obtusely on each face, and consequently having a solid form of twenty-four faces. The faces are rough as though shagrined. Light striæ in the lines of octohedral cleavage, which distinguish the diamond as a mineral species, are also observable.

Its specific gravity is, according to M. Halpham, 3.259 at 15° Cent.

Upon one of the faces of the diamond is seen a cavity of considerable depth, which may be recognized as due to an octohedral crystal formerly implanted upon it. The interior of this cavity, when examined by a magnifier, shows octohedral striæ; no doubt, therefore, that the crystal which has thus left its trace, was a diamond.

On the posterior part of the crystal, two other cavities of less depth are seen, also bearing the octohedral striæ on their sufrace; one of these shows traces of three or four crystals. On the same side of the crystal is seen a flat portion, where the cleavage may be seen. I am much inclined to regard it as a fracture; perhaps the point of attachment of this diamond to its gangue, whence it has been detached by the viluvial phenomena which have carried it off.

In addition, I will call attention to some black scales which appear to be titaniferous iron, a mineral frequently associated with crystals of quartz in the Alps and in Brazil.

From all these facts it results, that the *Star of the South* has originally belonged to a group of crystals of diamond, analogous to those of quartz, Iceland-spar, iron-pyrites, and crystallized minerals. The diamond will then be found lining geodes, in the midst of certain rocks, as yet unknown to us, but belonging, according to the observation communicated to the Academy in 1843 by M. Lomonosoff, to the metamorphic rocks of Brazil. This must be its true position, and in this respect the formation of diamonds will be analogous to that of most crystals, especially with the formation of geodes seen in the marble of Carrara.

The *Star of the South* was found, at the end of July, 1853, by a negress employed in the mines of Bogagen, one of the districts of Mines-Geraes. It is the largest diamond which has come to Europe from Brazil; the most celebrated diamonds heretofore being from India.—*Acad. des Scien. Paris, Jan.* 1855.

THE

MINING MAGAZINE.

EDITED AND CONDUCTED BY

WILLIAM J. TENNEY.

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ART I.—THE MINERALS OF CHILE.—BY PROF. J. LAWRENCE SMITH, OF LOUISVILLE.

THE minerals collected by the United States naval astronomical expedition were almost exclusively those of silver and copper. The specimens of the ores of these two metals, taken in connection with all authentic accounts, would lead one to believe that Chile hardly has a parallel in any region on the globe for the abundance as well as purity of these ores. Were it not for the physical difficulties connected with the surface of the country, and the scarcity of water and fuel, the wealth accruing to Chile from the working of these mines would be far greater than it is now.

Although the expedition furnishes no geological report of the country, it is thought proper, before describing the minerals in detail, to give some general idea of the geology of the country, more especially as connected with the minerals collected; and, for this purpose, recourse is had to the labors of M. Domeyko and M. L. Crosnier, as published in the "*Annales des Mines.*"

A general idea of the geological structure of Chile is readily formed, although we might be led to suppose otherwise from the great disturbing forces that have operated in that part of the world, in the form of injected masses of igneous rock, as well as from the present changes by existing volcanic action, and the gradual elevation of the whole country, with daily recurrence of earthquake action. These disturbing forces do not, however, in any way interfere with our study of the general geology of the country, while, of course, it renders the investigation of the geology of any particular region exceedingly embarrassing.

The great chain of the Andes extends parallel to the coast of Chile, at a distance of from 90 to 100 miles. On the eastern side, it descends by gradual slopes towards the immense plains of the Argentine republic. On the western side, where the upheaving force appears to have concentrated all its energy, the slopes are abrupt, and transformed frequently into vertical precipices of considerable height. The mountains appear heaped confusedly one on top of the other, and the first impression is, that, in the midst

of so much confusion, it is vain to seek for the primitive condition of the surface of Chile. Stratified rocks disappear entirely from north to south for the mean width of 45 miles—from the desert of Atacama to Valdivia. These rocks, although they once existed, are now profoundly altered or entirely melted by contact with the enormous masses of granite. The clay shales, which doubtless constituted the mass of the original stratified rocks, are now transformed into porphyries of every shade and of the most varied composition, alternating, in some parts, with beds of compact quartz. Even when the rocks are seen stratified, far removed from the masses of granite, and in beds sensibly horizontal or little inclined, still the numerous injected veins which traverse them, and ramify in all directions, prove that hardly anywhere have the rocks escaped the modifying force of igneous action.

Two immense granite elevations appear to have disturbed Chile in its entire length, parallel to the coast. One is immediately on the coast, with an average breadth of 45 miles, while the other is 100 miles east, in the midst of stratified rocks. The first range plunges into the sea, having valleys in various parts of it filled with tertiary deposits. As regards the respective ages of these two ranges, there appears to be a difference of opinion; some supposing that the range on the coast was first upheaved, and at a subsequent period the inner range, while others suppose them to have originated at the same time. But whichever one of these suppositions is true, the general characters of the rock of the two ranges are the same, as well as the metalliferous veins and accompanying vein rocks. Associated with the granite of these ranges, are hornblende rocks of the greatest variety, porphyries of all shades, containing crystals of feldspar, sometimes of considerable size. Besides these, there are other compact rocks, which cannot be properly classified.

The principal masses of secondary rocks that lay between the two ranges of mountains are composed of metamorphic porphyry, of a great variety of shades of color. Sometimes the porphyry is entirely altered; it then contains well-formed crystals of feldspar, and appears to have been melted where it now rests; and at other times it is earthy, as if the transformation has been incomplete. Large masses of reddish, yellow, and violet quartz, alternate with the porphyry, in certain points; also, calcareous beds, sometimes fossiliferous. These stratified rocks are elevated on the flanks of the Andes, and form some of the most prominent peaks of this range. These strata are so completely pierced and elevated in every direction by the masses of granite, as to modify in every possible manner their direction, inclination, and mineralogical character.

Besides the secondary stratified rocks just made mention of, there are other stratified rocks, which are horizontal, having been

deposited since the elevation of the mountain chains. They are all, however, of recent origin and of small extent, disseminated along the coast, with the exception of the sandy plain that extends between Huasco and Copiapo, having a length of from 120 to 130 miles, with a variable width. This plain has, however, been elevated since its formation; in fact, M. Domeyko has determined three distinct terraces of successive and gentle elevation.

There are also alluvial deposits now going on in some of the valleys of the elevated portions of the mountains, consisting of a fine clay, transported there by the mountain streams.

According to the observation of M. Crosnier, he has encountered but one formation that appears to be of lacustrine origin, and this is situated in the cordilleràs of Chillan, 45 miles north of Lavaderos.

The tertiary deposits subsequent to the elevation of the Andes contain, in many parts, lignite. Some of these places are worked. The principal mines are situated to the south of Biobio, some 20 miles distant from the mouth of this river, on the sea-shore. The mines are called Lota and Lotilla.

Some of the departments of Chile have been examined with minuteness by M. Domeyko, more especially that of Copiapo; which, although little else than a vast desert, is the richest department of Chile in mines of every description, there not being a single mountain where the veins are not of sufficient importance to be worked. And it is worthy of remark, that no mines are found higher than 4,500 above the level of the sea; and this peculiarity, I believe, pertains to all parts of Chile.

Taking the Bay of Copiapo as a starting point, and going east, we find the underlying rock of the country granite, the surface being covered with tertiary deposits of very modern origin, the same that is found at the mouth of all the Chilean rivers. These deposits form two or three terraces, and consists principally of sand, mixed with shell and gravel. At about six miles from the sea, solid calcareous beds show themselves, containing species of crustaceæ, now found living on the shore. The granite of this coast is fine grained, having the same aspect as that in neighborhood of Coquimbo, and is the same as that of the mountains of Carrisal, San Juan, and La Higuera, celebrated for their copper mines. Granite hills project frequently above the tertiary planes that extend to and rest on the first chain of granite rocks, which are low and rounded. It is in these rocks, wherever seen, whether on the coast or projecting above the tertiary planes, or, when still further east, projecting through secondary strata, that the copper and gold are found. A good example of this is the Cerro del Cobre mountain which elevates itself at the bottom of the valley of Copiapo. This mountain is composed of an elevated mass of porphyritic diorite, traversed by veins of iron and copper ores, containing considerable quantities of magnetic iron

and ferruginous oxide of copper, copper pyrites, &c. It forms a species of granitic island in the midst of stratified porphyritic and other compact rocks, more or less calcareous, and preserves all the characters of the cost rocks, even to the nature of the veins that it contains.

Further east, overlying the granite and dioritic rocks, are stratified porphyries; and here, at a height of 2,250 feet above the level of the sea, as at Ladrillos, commence the indications of silver, disseminated in extremely fine particles of chloro-bromide; but, on excavating, this indication soon disappears, and it is not until we reach a more elevated point that silver is found very abundantly, and where the stratification becomes more perfect.

Above the stratified porphyries there are calcareous and schistose rocks, more or less disturbed from their original position.

What is here said of the geological structure of the country east of Copiapo is true of many other parts of Chile, from the coast eastward. From these general views of the geology of Chile, I next pass to the consideration of the minerals collected by the expedition, accompanying the mineralogical description of them with an account of the manner of their occurrence. For the latter, I am also indebted to the geologists already made mention of.

GOLD.

Native Gold.—The specimens of this metal were contained in quartz rock, exhibiting all the usual characteristics of auriferous quartz. The gold contains silver, with but a trace of copper. In Chile, this metal is found in veins as well as in the drift; the whole granite of the country is traversed by quartz containing more or less gold, associated with the peroxide of iron; and, at some depth from the surface, with iron pyrites; sometimes with cupreous pyrites, arsenical pyrites, blende, galena, and sulphuret of antimony. These veins, by their decomposition, furnish auriferous deposits of considerable extent that are now worked.

Mention is made by M. Crosnier of a number of gold deposits, irregularly disseminated in the midst of decomposed granite and red clay, which contains a large quantity of peroxide of iron, and which appears not to have originated from the decomposition of regularly formed veins. This fact is apparent in the neighborhood of Valparaiso. It is also stated that gold is found in clay, more or less ferruginous, arising from the decomposition of the granite in the most elevated portions of certain mountains, consequently in a situation where it should not have been carried by water.

It is supposed that the gold came up with the mass of granite at the time of elevation of the latter, and not by subsequent injections of veins; and, in most instances, iron pyrites is regarded as its original associate. This character of auriferous formation

is, of course, the exception, as, in most instances, the gold is traceable to regular veins, or to the decomposition of these veins. Although gold seems to be quite generally distributed through Chile, but few of the deposits remunerate exploration; the most extensive are on the flanks of the Andes, about 40 miles east of Chillan, where it exists to the depth of 35 feet in a very fine yellow clay, mixed with black sand; the yield of gold is not very great.

COPPER.

Native Copper.—This is very commonly found in all the copper mines of Chile. In one specimen, from Andacollo (Coquimbo), it was found crystallized in modified octahedrons; it is very commonly associated with the red oxide of copper, as beautifully shown by a specimen from Illapel (Coquimbo). It is also found with copper in quartz at Andacollo (Coquimbo). Others of the specimens came from San Jose, San Pedro Nolasco, Hinchado, Higuera, and Aconcagua.

Red Copper.—This mineral is found beautifully crystallized in octahedrons, more or less modified. The most beautiful specimens of this description are from Coquimbo; other specimens are massive and granular.

Its hardness is 3.5; specific gravity, 5.9. Its color is various shades of bright red, and the crystals are transparent, although, from the exceeding intensity of their color, they must be examined by a strong light.

This mineral is quite brittle, and is composed of—

Copper	88.88
Oxygen	11.12
	100.00

Formula is $Cu^2 O$.

It sometimes forms veins, coated with green and blue silicates of copper, in the mines of Camarona and Cortadera in the province of Coquimbo. In the Andacollo mine it is found pure and abundant, below the oxy-sulphuret, resting on metallic copper, with which it is very commonly mixed. Aconcagua also afforded specimens. At Illapel it is found, containing native silver.

Capillary Red Copper.—This beautiful form of the oxide of copper is found in fine delicate rhombohedral crystals. It was found in the cavities of massive specimens of the red copper, from Aconcagua. The crystals are as small as the finest hair, and sometimes half an inch in length. Its color is crimson red; specific gravity, 5.8. Its composition is the same as the last described mineral.

Tenorite, or Black Oxide of Copper.—This is found massive, al-

most always mixed with other minerals of copper. It has a black metallic lustre, and when pure contains—

Copper	79.86
Oxygen	20.14
	100.00

Its formula is Cu O.

Atacamite.—This mineral was first discovered in the sands of the desert of Atacama, and hence its name. It is crystallized in modified rectangular prisms, and retangular octahedrons. Its color is of a dark emerald green, almost black at times. It is translucent; has a hardness of from 3 to 3.5, and a specific gravity of about 4.00. It consists of water, chloride and oxide of copper, and contains, according to analysis of Ulex—

Chlorine	16.12
Oxide of copper	56.23
Water	11.99
Copper	14.56
Silica	1.10
	100.00

Corresponding to the formula Cu Cl+ 3 Cu + 3 H.

This mineral is also fonud in the district of Tarapaca. It is ground up in Chile, and is used as powder for letters, under the name of *arsenillo.*

Copper Glance.—The specimens of this mineral examined were all massive, of a black metallic lustre, soft, and easily cut with a knife, having a specific gravity of 5.7. It commonly has green and blue carbonate disseminated through the mass. It is composed of—

Copper	79.8
Sulphur	20.2
	100.0

Having for its formula Cu^2 S.

It is most abundant in those mines furthest from the coast, existing in secondary stratific porphyry, and sometimes containing a notable amount of silver. It is also found abundantly in the mines of Chile that are near the coast, and are in dioritic and porphyritic rocks; but in them it is rarely found pure, being always mixed with the black oxide of copper or the oxy-chloride, The specimens examined were from Copiapo, although there are numerous localities. It is remarkable that, at San Antonio, this mineral is associated with native silver, and yet often contains hardly

more than one thousandth of this latter metal. Specimens of pure sulphuret of copper are found, in which metallic silver is imbedded in the form of grains or little plates; and the same sulphuret contains grains and plates of native copper, entirely separate from the silver.

Erubescite, or Purple Copper.—This is one of the most abundant of the minerals of copper found in Chile. It is procured in large quantities at the mines of Tamaya in Coquimbo, Los Sapos, and Higuera. No crystals were seen. It is massive, of a purplish, variegated color, with a metallic lustre. It is brittle, and not very hard. When the surface is freshly broken, it is of a brass color, that very often tarnishes, acquiring a purplish hue. The massive varieties of this mineral always vary more or less in their composition. The specimens examined contained from 55 to 65 per cent. of copper. Three specimens, they have been thoroughly analyzed by M. Domeyko, gave—

	Tamaya.	Los Sapos.	Higuera.
Copper	66.7	56.1	59.5
Iron	8.9	17.7	18.2
Sulphur	22.8	23.1	20.5
Quartz	1.6	3.1	1.8
	99.8	100.0	100.0

The formula is $Fe\,S + 2\,Cu^2\,S$.

This mineral furnishes a great deal of the copper produced in Chile.

Copper Pyrites.—This is the most abundant copper ore of Chile, and is found in immense quantities in the province of Coquimbo; some of it, as that from Tamaya, contains .0025 per cent. of silver, while that of another mine contains gold. All the specimens were massive, of a brass yellow color, metallic lustre, fresh fractured surfaces tarnishing readily. In fact, it possesses all the known characteristics of this mineral as found elsewhere. Its composition, when perfectly pure, is—

Sulphur	35.05
Copper	34.47
Iron	30.48
	100.00

Several specimens examined gave—

	1	2	3	4
Sulphur	33.05	37.22	.....	.....
Copper	36.60	33.67	31.02	35.01
Iron	29.33	28.56	.....	.....
	98.98	99.45		

Its formula is $Cu^2\,S + Fe^2\,S^3$.

This mineral is rarely found in granite, but often in hornblendic and porphyritic transition rocks, accompanied by iron pyrites, magnetic iron, asbestos, quartz, and various species of clay; very rarely with carbonate of lime. The most important mines yielding the copper pyrites are Carrisal, Atacama and Higuera, Brillador, Tambillos, &c., in Coquimbo.

Arsenical Gray Copper.—Gray copper appears not to be found very abundantly in Chile; there are, however, three varieties of it, one of which contains quite an amount of mercury, another having the composition of ordinary gray copper, while a third abounds in arsenic. They all three possess the ordinary physical characters of gray copper; namely a steel-gray and iron-black color, with metallic lustre, rather brittle: hardness 3 to 4, with specific gravity varying from 4.5 to 5. No specimen of this variety was obtained. It is found at San Pedro Nolasco, and its composition, as made out by M. Domeyko, is—

Copper	48.5
Iron	4.8
Zinc	2.3
Silver	0.3
Arsenic	11.4
Antimony	6.4
Sulphur	26.1
	99.8

Mercurial Gray Copper.—This is found in some of the mercurial mines of Chile in small amorphous masses, disseminated in a quarter gangue, accompanied by the blue-carbonate of copper and a red earthy substance of deep red color, apparently an antimoniate of mercury. This also has been analyzed by Domeyko, with the following result—

Antimony	20.7
Iron	1.5
Zinc	trace.
Copper	33.6
Mercury	24.0
Sulphur	20.2
	100.0

Antimonial Gray Copper.—This is the common form of gray copper, and several specimens were brought home by the expedition; it contained but a small amount of silver, as seen by the following analysis—

Sulphur	26.83
Antimony	23.21
Arsenic	3.05
Copper	36.02
Iron	2.36
Zinc	4.52
Silver	3.41
	99.40

The formula of gray copper is represented by—

$$(4\ Cu^2,\ Ag,\ Fe,\ Zn)\ S + (Sb\ As)\ S^3.$$

Besides the above species of gray copper, others are found, which, whether arsenical or antimonial, contain only a few thousands of mercury; these varieties are almost invariably destitute of silver.

Domeykite, Arsenical Copper.—This mineral is massive, of a tin-white color, with a metallic lustre, and specific gravity of 4.5. It is about the hardness of copper pyrites. The specimen examined was not a pure one; it furnished—

Arsenic	22.08
Copper	72.41
Iron	3.22
Sulphur	2.01
	99.72

Perfectly pure specimens, according to Domeyko, contain—

Arsenic	28.36
Copper	71.64
	100.00

Which give the formula $Cu^3\ As$.

It is found pure without any admixture of sulphuret near Illapel, in the same veins which, near the surface, yield red copper with native silver; it is also found in some of the silver mines of Atacama, particularly in those of San Antonio.

It is almost always mixed with copper pyrites in varying proportions, and sometimes with the oxide and amorphous green arseniate of copper.

Besides this species, there is found in the Cordilleras a kind of white native copper, obtaining from 3 to 5 per cent. of arseniuret of copper and resembling native silver.

Olivenite, Arseniate of Copper.—It always accompanies the arseniurets and is amorphous, with a compact earthy structure, green color, with varying shades, and is always mixed with carbonate and silicates of copper. This mineral it appears is never found perfectly pure in Chile; but when pure, as found elsewhere, it contains—

Arsenic acid	31.78
Phosphoric acid	6.57
Oxide of copper	58.34
Water	3.31
	100.00

and the formula is—

$$Cu\ (As,\ P) + H.$$

Chrysocolla, Silicate of Copper.—This is very commonly found

in all the copper veins of Chile, always massive, sometimes in the form of mamillary coatings and concretions. It is of various shades of green and blue, sometimes of a dark and almost black color. Its specific gravity is 2.2; it is easily crushed. It is not an easy matter to find the chrysocolla perfectly pure. The specimen that furnished the material analyzed was a mass of copper pyrites, covered with a mamillary coating of the silicate, which was detached with much care. It furnished—

Oxide of copper	42.51
Silica	31.35
Water	21.62
Oxide of iron	1.97
Alumina	2.83
	100.28

Corresponding very nearly to the formula—

$$Cu^3 Si^2 + 6 H:$$

other specimens were found to contain oxide of copper varying from 20 to 50 per cent.

The name Llanca is given by miners to silicate of different shades of green and blue, which very often accompanies the copper minerals, especially the oxy-sulphurets, forming the envelope of some veins, constituting masses in which native copper, red oxide, carbonate, and at times sulphurets of copper, are found. Most of the copper veins in Chile abound in these silicates near the surface. The basic silicate found in many of the copper mines of Coquimbo are always in the upper parts of the veins, forming narrow seams, between red oxide and green and blue Llanca; it is frequently mixed with the black silicate—La Higuera and San Lorenzo furnished the specimens examined.

Azurite, Blue Carbonate of Copper.—This occurs both crystallized and massive. Among the specimens was one crystallized on copper pyrites, from Andacollo. It possesses all the common characteristics of this mineral, as found elsewhere, and is composed of—

Oxide of copper	69.09
Carbonic acid	24.69
Water	5.22
	100.00

The formula representing it is—

$$2 \, Cu \, C + Cu \, H.$$

It is found in many localities, associated with the ores of copper.

Malachite, Green Carbonate of Copper.—This mineral exists abundantly in Chile, but is not found in those large compact masses (such as are procured from Siberia and some other places)

out of which ornaments are made. It has no peculiar properties in which it differs from the malachite of other localities. Crystallized specimens were procured from Tortolas and Tamaya. Other specimens came from Tarienta, San Jose, &c. Its composition is—

Carbonic acid	20.
Oxide of copper	71.82
Water	8.18
	100.00

Formula is $Cu^2\ C + H$.

Blue Vitriol, Sulphate of Copper.—This salt is found associated with the sulphate of iron and alumina, at Tierra Amarilla, in the valley of Copiapo. It arises from the decomposition of copper pyrites. It is constituted of—

Oxide of copper	82.14
Sulphuric acid	81.72
Water	86.14
	100.00

Its formula is $Cu\ S + 5\ H$.

Volborthite, Vanadate of Copper and Lead.—This rare mineral was first noticed in Chile by M. Domeyko, in the Mina Grande, about 6 miles from the silver mines of Arqueros. It is an amorphous substance, porous, heavy and of a dark brown color. It lines the cavities of an arsenio-phosphate of lead. At first view, it would be confounded with the hydrated oxide of iron, from which it differs, however, by its great fusibility and ready solubility in nitric acid. There was no specimens sufficiently pure for analysis. Those examined by M. Domeyko gave—

	1.	2.
Oxide of lead	54.9	51.97
Oxide of copper	14.6	16.97
Vanadic acid	18.5	18.33
Arsenic acid	4.6	4.68
Phosphoric acid	.6	.68
Chloride of lead	.3	.37
Silica (?)	1.0	1.33
Lime	.5	.58
Oxide of iron and alumina	3.5	3.42
Earthy residue	1.0	1.52
Loss by heat	2.7	2.70
	97.20	97.55

Giving for its formula $Pb^6 + Cu^6\ V$.

This differs somewhat from the formula furnished by the analysis of the volborthite, as found in the copper mines between Miash and Katherinenberg, Russia; but, as the Chile variety has not yet been found crystallized, the differences may be due to impurities.

Remarks on the Copper Minerals.—The minerals of copper have been described after gold, from the fact that the great mass of them occur in Chile in the same geological formation as the gold. It is the granite that is most commonly traversed by copper veins, sometimes of a considerable size. Along the coast it is found in the form of copper pyrites alone, or associated with two varieties of iron pyrites, and also as peacock or purple copper. Galena and blende are rarely found with them, and scarcely ever gray copper. Native copper, red oxide, oxy-chloride, oxy-sulphuret, green carbonate, and hydrous and anhydrous silicates of copper, of a great variety of colors, are also abundant, especially at the upper part of the veins. The silicates sometimes line the walls of the veins, and penetrate to some distance in the enclosing rock, which becomes unequally colored blue or green. The numerous veins of copper are disseminated very irregularly in the granite, and their value is equally variable; sometimes the veins have a breadth of from 6 to 9 feet, as at Tamaya, near Coquimbo, where, at the depth of 600 feet, there is a daily yield of from 8 to 10 tons of an ore yielding seldom less than 50, and oftentimes as much as 75, per cent. of copper.

[To be continued.]

ART. II.—GEOLOGY OF MISSOURI. By J. HAWN, ASSISTANT GEOLOGIST.

SIR: In carrying out your instructions, I commenced an examination of the country between the Missouri and Mississippi rivers in November last, beginning at St. Joseph, and terminating at Hannibal.

I adopted the line of the Hannibal and St. Joseph Railroad, as the base of my operations, and made lateral researches to a distance of fifteen miles, the extent of my district.

My examinations then were preliminary, having more in view general results than connected details, enabling me, subsequently, to conclude the survey with more accuracy and dispatch. After being relieved from subsequent duties under your immediate supervision, I resumed the examinations, and concluded them a few days since, and herewith present you with my report.

In order to simplify detailed description, I have classified the vertical section into such sub-series of strata as are peculiar to extended localities; commencing with A, and noting in alphabetical and descending order.

It would be superfluous to dwell upon the geological or physical features of the valley proper of the Mississippi river, as that part of the field was examined by you in person.

In commencing my more detailed examinations, the first locality examined was at a point on Salt river, eight miles south-

west of Hannibal, where the Hannibal and New London Plank Road crosses that valley. At this place, the river has excavated a valley to the depth of some two hundred and forty feet, leaving exposed mural escarpment on the north side of one hundred and fifty feet of compact Trenton limestone, which is fully described in your general section.

It has occurred to me that this rock would be admirably adapted to many kinds of structures, in landscape gardening, such, for instance, as imitations of ancient views. The cavities would hold sufficient soil to support a luxuriant growth of cacti, as well as many kinds of vines, whilst the harder portions of the rock have solidity enough to sustain a structure that would be firm and lasting.

This formation may be traced along the northern slope of the valley, for fifteen miles above, or west of the plank road. Here, I observed several salt springs; the most important is known by the appellation of "Muldrow Lick." The water of this spring was formerly used in the manufacture of salt, but it is not of sufficient strength to make it profitable now.

On the south side of the valley, this formation (Trenton limestone) is only traced for three miles above the plank road, where it passes out of view by a dip towards the west. This dip is sufficient to bring down the lower portions of the encrinital limestone to the same level as the Trenton, in the short space of half a mile.

In a distance of five or six miles further west, or up the river, the hills on the south side of the valley are wholly composed of encrinital and chouteau limestone, supported by the vermicular sandstone: whilst the whole northern slope of the valley, immediately opposite, is composed of Trenton limestone.

Here, then, we have an interesting example of the disturbances and upheavings of strata, by the operation of internal forces, by which rocks belonging to entirely different systems, occupying, in their original undisturbed condition, widely different elevations, are brought upon the same horizon.

The above-mentioned dip together with a similar one to the east, or towards the Mississippi river, forms an anticlinal axis, the trend of which is nearly north and south, extending beyond the southern limits of this district, as you have observed in your reconnoisance of the country, between Hannibal and Louisiana. On following this axis of elevation north, it is found to terminate on the north side of the valley of Salt river, by a northern dip of the strata, so that in going to Hannibal, on the Mississippi river, only eight miles north of Salt river, the Silurian rocks which are seen in the bluffs on Salt river, two hundred and forty-five feet in thickness, are wholly submerged beneath the water at Hannibal. This fact will, also, be more clearly illustrated by your section along the south side of Marion county, which is situated nearly parallel with Salt river, and only six miles north of it.

In following up the valley of Salt river I find that on the north side, at Cincinnati, on Sec. 8, Town. 56, R. 6, the Trenton limestone is lost sight of, in consequence of a dip towards the west, under a similar condition to that mentioned as occurring on the south side of the valley, a few miles below. The upper portion of the bluff is here composed or encrinital and chouteau limestone, one hundred and twenty feet in thickness. Beneath the base of the chouteau limestone, there is a slope of some eighty feet perpendicular height, in which is exposed broken fragments of shale, belonging to the vermicular sandstone.

At Newport, four miles above this, the section exposed is the same as at Cincinnati, except that shale is seen in place, under the chouteau limestone.

From Newport I crossed the river, and examined on S.E. ¼, Sec. 33, Town. 55, R. 7, for the first time, a locality of the Lick Creek coal fields. The order of superposition of the beds composing this portion of the coal-bearing strata, will be better understood by examining the following sections:

No. 1—5 feet bituminous shale, of a loose thinly laminated structure, interstratified with fine ashy silicious earth-like matter, with small globular concretions of like material, and occasionally a large, dark blue, calcareous concretion, of a flattened ovoid form, of some 200 or 300 pounds in weight.
No. 2.— 1½ feet coal.
No. 3.— 26 " slide, with fragments of chert.
No. 4.—140 " white Encrinital limestone.
No. 5.— 20 " gray Chouteau limestone.
No. 6.— 15 " slide, to bottom of creek.

This section was overlaid by the loess to the depth of fifteen feet. On the S W. ¼ Sec. 25, Town. 54, R. 7, the following section was observed:

No. 1.— 13 feet loess.
No. 2.— 2 " blue impure limestone.
No. 3.— 8 " blue argillaceous shale.
No. 4.— 6 " bituminous shale, similar to the preceding section No. 2.
No. 5.— 2 " coal.
No. 6.— 3 " yellow, or fire-clay.
No. 7.— 82 " slide, with broken fragments of arenaceous shale.
No. 8.— 60 " white encrinital limestone.
Bed of Lick Creek.

On the Northeast quarter, Section 12, Township 54, Range 8, the following section is seen:

No. 1.— 3 feet bituminous shale.
No. 2.— 1½ " coal.
No. 3.— 2 " yellow clay.
No. 4.— 2 " bluish gray, concretionary impure limestone.
No. 5.— 3½ " yellowish brown, impure limestone.
No. 6.—35 " Archimedes limestone.

This section is overlaid by twenty-two feet of loess.

The foregoing sections embrace most of the strata belonging to the Lick Creek coal-fields, as observed in most of the area of the district south of Salt river, west of Lick Creek, and north fork of Salt river and the Grand Divide. At the latter point,

this section is augmented by the interpolation of other beds, including one of coal.

The organic remains of this section are numbers 2, 3, 4, 9, 11, 12, 13, 15, 16, 19, 22, 23, 26, 29, 30, 33, 35 and 40, of the catalogue appended to this report.

The upper limestones of this series seem to possess hydraulic properties, and are found in the greatest abundance, near the surface, in the vicinity of Paris, Monroe county. Between Lick Creek and the south fork of Salt river, the coal of this section is most available. Here, the stratum occupies a horizontal position near the surface, and is from twenty to twenty-four inches in thickness. It is of compact laminar structure; imperfect conchoidal fracture; a light, lustrous black color; burns freely; and, when free from pyrites, is of excellent quality. Outcrops are so numerons that it is superfluous to mention localities. It is sufficient to say that it is found in every ravine, and on nearly every quarter section. The facilities for mining are superior, as the underlying stratum is of a consistency that will render excavation comparatively easy, whilst the small amount of superincumbent strata will not require expensive props to support the cap-rock.

Coal is found in small quantities north of Salt river, and east of the north fork, on Section 27, Town 56, Range 8, and a few other places; but their position is equivocal, being, probably, only outliers of beds farther west.

The coal of the Lick Creek section is also found on the north fork of Salt river, on section 5, Town. 56, Range 9 and vicinity. The stratum is about eighteen inches in thickness, and is overlaid by argillaceous shale, highly impregnated with alum. These are supported by ten feet of dark gray, impure limestone, interstratified with hard, compact with yellowish gray slate, chert, and small, globular, silicious geodes, the cavities of which are filled with crystals of quartz. The upper portion of stratum merges into a yellow shale, upon which the coal rests, and the lower portion passes under the bed of the river.

About twelve miles up the river, at a point nearly due south of Shelbyville, coal is found in connection with a saccharoidal sandstone highly quartzose, and Archimedes limestone. The stratum is about twenty inches of medium quality, and probably also belongs to the creek series. In this vicinity, I observed a great number of geodes, filled with crystals of quartz, of nearly every variety of form and size.

They vary from two to fifteen inches in diameter; they are spheroidal.

No coal was found north of this point, but I see no good reason why it should not be found as far north as the northern limits of this district.

At or near Sharpsburg, on Section 2, Township 56, Range 8, the

encrinital limestone is immediately overlaid by forty feet of brown micaceous sandstones: and frequent indications tend to the conclusion that this is the surface rock, between this and the Grand Divide, and for sixty or seventy miles beyond; but at that place (the Grand Divide) are interpolated between it and the supporting rock, several strata, not represented in the section at Sharpsburg. Similar interpolations are repeated in going west, until this sandstone is found overlying nearly all the series of the coal measures. This rock will be noticed more fully hereafter.

The inundation of the lower coal-bearing rock hitherto described, and represented in the different sections, consists of the lower Carboniferous beds. This order is preserved along the valley of Salt river and its principal branches, to meridian passing through Paris, Monroe county, and in some instances farther west, where they pass out of view by the superior elevation of the country.

These formations are found over nearly the entire country east of the meridian indicated, and will become of great importance in furnishing excellent material for building purposes, including ornamental structures and monuments of a simple order of architecture. Rocks for burning a superior article of lime, may be selected at almost any locality. Organic remains, similar to those of your catalogue of encrinital limestone.

From the Grand Divide to Grand Charlton, the strata dip towards the west, and the section hitherto under consideration, passes under, and is succeeded by other strata, in the ascending order, which are represented in the vertical section by Nos. 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, and 56. This section is found in the valley of Clay Bank Creek, an eastern tributary of middle fork of the Chariton, three miles north of McGee college, in Macon county.

For organic remains, see Catalogue. Nos. 3, 11, 12, 16, 17, 18, 19, 20, 26, 30 and 32.

Vegetable impressions occur in the lower portions of stratum No. 46, of a flattened stem-like form, promiscuously intermingled with the rock, and forming about one-eighth of the entire mass. The sandstone is hard, and generally of a light yellowish brown color, changing in places to a dull, bluish gray. This is underlaid by about twelve feet of argillaceous shale, changing to an arenaceous slate in some localities. These rest upon No. 49, the most important coal-bed in this district. At B. Powel's bank, on section 14, Township 56, Range 15, it is six feet in thickness, including a six inch stratum of clay, and has a fine laminated structure, with a dull black, charcoal color and appearance. It is very light; burns freely, and contains but little pyrites. Judging by its lightness, I should suppose it would produce but a small proportion of ash or residuum. Its freedom from sulphuret of iron, renders it a valuable coal for steamboats and smiths. By accident fire was communicated to this stratum, on the premises

of E. S. Gibson, Esq., which revealed its existence at that point. After burning several weeks it was extinguished with much difficulty.

I traced this stratum west to Fish trap ford on Grand Chariton, in the north-east corner of Chariton county, where I found it on a level with high water mark. To the north, it soon passes under the bed of the river.

Stratum No. 52 burns into good lime, and may be used for underpinning.

Stratum No. 55 is an inferior article of coal, containing too much sulphuret of iron.

The coal in this section is extensively available in the district between East and Grand Chariton rivers, and again in the valley of Grand river, west of the high grounds included in the Elk Knobs.

At some localities, stratum forty nine, and the shale above it, were subjected to the denuding action of water,* by which the surface was cut into small ravines and cavities resembling cross-sections of small hollows, which were subsequently filled up with different material. In one instance it is composed of broken fragments of sandstone; at another point, the space is occupied by a hard, dark ferruginous conglomerate, composed of sand and gravel, and at still another the coal appears to be entirely cut away, and the interval filled with a beautiful red clay. This locality was formerly much visited by the aborigines, who made extensive use of this clay in painting their implements and decorating their persons.

On Rocky Branch, on the west side of the valley of Grand Chariton, two miles below the railroad, strata from No. 35 to 42 inclusive, are found cropping out.

No 42 is a hard, compact, impure limestone, suitable for ordinary building purposes, but the available quantity is too limited to be of great importance.

Stratum 46, in the preceding section, is here a compact sandstone, that weathers well, and may be used for some structures to a good advantage.

No. 38 is a coal similar in character to that of No. 49, hitherto described, and is two feet thick.

The fossils obtained at this locality may be seen in catalogue Nos. 8, 12, 16, 17, 18, 21, 26 and 30.

* In the valley of East Chariton I observed a surface of smooth, hard limestone, marked with two courses of striæ; one bearing south ten degrees east, and the other south, twelve degrees west; and crossing each other. The lines of the working in each course are parallel and one foot or more apart. Those bearing east are partially curved, with occasionally light striæ between the principal parallels. The grooves are angular, remarkably smooth and regular, about three-fourths of an inch in depth, and some are twenty-five feet in length. The surface thus marked, includes an area of about four hundred square feet, and is so prominent that it attracts the attention of the most casual observers. This locality is in the bed of East Chariton river, three miles south-east of Bloomington, Macon county.

This section, and the preceding stratum, is very generally found in this valley on Muscle fork, and strata Nos. 38 and 39 on Little Yellow, below Harvey's mill.

Between Little Yellow creek and Grand river, the strata from 26 to 34, as observed on Little Yellow creek, north of the railroad and Utica, Livingston county, furnish good building materials; but, at most of the other localities, these rocks would not withstand the vicissitudes of the atmosphere.

The organic remains obtained are Nos. 1, 3, 7, 9, 11, 12, 16, 17, 18, 19, 21, 23, 26, 27, 29, 30, 33, and 39 of the catalogue.

Immediately above the section on Rocky Branch, and on Little Yellow, or east of Coulston's mill, over the section last under consideration, we again meet with the micaceous sandstone of Sharpsburg, before mentioned. At the former point, and in the Elk Knobs, it appears to have attained a thickness of some hundred and fifty feet, and increases in thickness northward, probably in consequence of having been less exposed to denuding forces in that direction. It probably constitutes the principal formation in the Elk Knobs, which constitute the peculiar topographical feature of the country north of the Hannibal and St. Joseph Railroad, and west of Grand Chariton. "They consist of short conical ridges, formed by irregular ravines. Two often head in a point common to both, and after running in opposite directions, curve abruptly and unite again, thus forming what is generally called 'The Knobs.' Some of them are so regular in contour, that they resemble more the works of art than of nature.

The tendency to this peculiarity may be traced along the line of the railroad to Little Yellow creek, and north of this over the higher portions of Linn county, and west of Grand river, between Monroe's Bluff and the Blue Mounds in Livingston county.

In the valley of Grand river, this sandstone has been worn away to give place to that stream.

At Utica, in Livingston county, near the junction of the forks of Grand river, it appears in a cliff, one hundred feet high, and there passes under the limestone of the overlying coal measures.

The strata Nos. 21 to 25 inclusive, next appear, and are mostly composed of Sharpsburg sandstone, or that formation just under consideration, including two strata of coal. In this sandstone, at this locality, are many remains of plants and concretions, with nuclie of vegetable and other matter.*

* On Big Branch, seven miles west of Utica, the fossil stump of a tree is seen, that originally must have been two feet in diameter. It resembles a stump far advanced in decay: it is partially carbonized; has a brownish black color, and burns readily. The bark and roots are obvious, and its ligneous structure is observed at a glance. Its composition is entirely distinct from the rock in which it is embedded, though many small particles of a similar substance are found incorporated with the rock.

The upper stratum, No. 22, is worked on the land of Mr. Joseph Clark, on the valley of the west fork of Grand river, on the north-east quarter Section 8, Town. 56, Range 25. This stratum is about eighteen inches in thickness, and of medium quality. Unless it is confined to a small area it should be found on or near the summit of the bluff at Utica, in the Blue Mounds, below the lower limestone, and along the two forks of Grand river to the northern limits of this district.

With this series terminates that portion of the coal measures known to contain beds of workable coal, as no coal in any useful quantities is found in the series above.

It will be seen, from the preceding, that there are at least five beds of coal included in the coal measures of this district, with an aggregate thickness of eighteen feet. This will furnish an inexhaustible supply of one of the most important elements of future wealth and prosperity. Though the quantity and value, according to present standards, may be expressed in numbers, yet the effects it will produce in the development of the great interests of social life cannot be foreseen or estimated.

The next strata in the ascending order, Nos. 11, 12, 13, 14, 15, 16, 17, 18, 19, and 20, are composed of limestones of various colors and grades of purity, with a few beds of shale, as the vertical section indicates. Their aggregate thickness is near a hundred feet, and they are the surface rock of nine-tenths of the district west of Grand river.

At Utica, and White's Mills, on Shoal creek, they are seen resting immediately upon the Sharpsburg sandstone. At Jacob Hulser's, Section 19, Township 56, Range 27, they are well exposed, and likewise in the valley of Grindstone creek, Dekalb county, where they also overlie the Sharpsburg sandstone. From the extensive exposures of that formation, in the lower portions of the valley, the stream takes its name. The upper portions of the sections are exposed at different points along the valley of Shoal creek, to the head of the stream, on Bush and McDaniel creek, on Smith's fork, near Plattsburg, on Castile, and third fork of Platte river; and it is wholly seen in the high rocky bluff of "Bond Town," about St. Joseph.

A few feet above this I observed many impressions of leaves of plants; and still higher, a large shell, resembling some varieties of our fresh water Unio.

The lower stratum of coal, No. 24, in this section is found cropping out in the cliff at Utica, about thirty feet above the water line of the river. It is from fourteen to twenty inches in thickness, and of good quality. It is, also, found in Monroe's bluff, at several points between that and the Blue Mounds, at the head of Brush creek, and on Clear creek, at the base of the Blue Mounds. It is also found on the east fork, a few miles north of Chillicothe, the county town of Livingston, and on the premises of Dr. Gilbert on Medicine creek, and should be found in the valley of Shoal creek, between Hixon's and Hahan's old mill.

The fossils* observed in these strata are Nos. 3, 5, 6, 8, 9, 10, 11, 12, 16, 17, 18, 19, 23, 24, 25, 33, 35, 36, 38, and 41 of the catalogue.

In addition to these, there are some two or three varieties that are new.

Many of the strata of this section will answer a good purpose, for underpinning bridge abutments and for rough stone buildings; while but few are capable of receiving a dressing, sufficient for fine work. No. 14 is composed of pure white limestone of an oolitic structure, remarkably compact, and well adapted to fine work. It is massive, but may be quarried or split into any convenient form. It is available in the valley of Shoal creek, in the vicinity of Kingston, in the valley of Castilefive miles below the Hannibal and St. Joseph railroad, and, probably, in the valley of Grindstone. It would, also, make excellent lime.

No. 10 in the vertical section, as seen at Skinner's mill, is also an excellent building material, particularly for heavy abutments and arches; but it is too high in the series to be available, except on some high points on the Missouri river.

This series will furnish many localities west of the east fork of Grand river, with good and convenient rock for general purposes in building, and at some few points, the common ornaments, such as window and door sills.

Stratum 11 is composed of disintegrated chert, of a dull, reddish brown color, varying from that to a creamy white; is a light porous substance; at some localities it has attained a considerable density, with portions of chert incorporated; at others it is soft and friable. Where this has been subjected to disintegration, it leaves many fragments of chert, as is seen at Flint hill, two miles south of Kingston. This stratum furnished me a convenient guide in ascertaining the relative position of strata in the series.

In the valley of Grindstone, Section 8, Township 57, Range 31, is found a red, chocolate-colored, silicious clay, or shale, which, from its similarity in many respects to a material extensively used in Ohio and other States as a pigment, would doubtless furnish a cheap and abundant material for that purpose. When ground in oil the color may be varied by adding a small quantity of white lead, lampblack, or other cheap paint, to suit the taste. This kind of paint is highly useful, not only for ornamental purposes, but also for rendering roofs fire-proof, by applying several heavy coats to the shingles. So soon as the oil evaporates, the strong coating of silicious matter left on the surface will prevent a roof from taking fire from sparks, or even large coals.

* Strata Nos. 10 and 12 of the vertical section abound in organic remains, which are most abundant at the heads of Smith's Branch in the vicinity of Plattsburg. A good collection may be had at many localities in that vicinity.

Strata 2, 3, 4, 5, 6, 7, 8, and 9 in the vertical section, are mostly composed of arenaceous matter, and constitute the formation of the upper portions of the Blue Mounds. The only stratum in this series worthy of particular note, is No. 5. This is composed of dark brown, variegated, and the buff-colored sandstone, twenty-one feet in thickness. When first removed from its native bed, it is soft, and easily worked into any useful form; but, when exposed to the atmosphere, it hardens and is covered with a coating of white silica, that renders it comparatively impervious to water, and so hard and quartzose that it readily yields sparks with the steel. This will, undoubtedly, be found a cheap, durable, and convenient building stone, and, on that account, valuable. This stratum is seen at the heads of Clear and Mound creeks.

The highest stratum, or No. 2, is a light gray limestone, that would, probably, burn into tolerably good lime.

Except the Quaternary deposits, this series is the highest in the vertical section; and the Blue Mounds, in which they occur, the highest point in the district, as no representative of any portion of the strata is found elsewhere. I observed the same formation in the high grounds west of Fort Leavenworth, Kansas Territory.

These mounds are situated about ten miles south of the forks of Grand river. On the north side they rise rather abruptly to an elevation of some three hundred and fifty feet above Grand river valley, and gradually recede towards the south-east and north-west and south of south-west, until they again merge into the common level of the country. Their area I should judge to be equal to one and a half congressional townships.

Their topography, undoubtedly, gave rise to their name; for they have that peculiar regular contour of surface and mound-like form incident to districts where the frame-work of the country is composed of strata that disintegrate readily, or are easily worn away.

Notwithstanding the elevated and broken aspect of this mound country, it is very productive, especially the northern portion. The reason of this will appear in the description of the next series or the superficial deposits.

This section closes the vertical section, so far as relates to the stratified or sedimentary rocks. I shall, therefore, make a slight reference to their general position.

The distance across the State, between Hannibal and St. Joseph, is two hundred and ten miles, and the bearing varies but little from a due west course.

The bed of the Missouri river at St. Joseph is elevated three hundred and wenty-five feet above that of the Mississippi at Hannibal; and the aggregate thickness of the strata between these points amounts to eight hundred and thirty feet.

The principal coal beds as observed, in Macon county, are

nearly on the same horizon with the bed of the Missouri river, at St. Joseph; but at the latter point the superincumbent strata, below the bed of the river, amount to three hundred and fifty-five feet; and in no portion of the district can these coal strata be reached, in the valley of the Missouri river, in less than three hundred feet below the surface; premising, however, that the strata are constant in their thickness and horizontal position.

The strata generally increase in volume in going west, especially those of shale, which also become more arenaceous.

QUATERNARY.

The loess, from ten to seventy feet in depth, is the principal deposit of this age, and extends from the Mississippi to the Missouri river. It is similar in all its characteristics to that you extensively observed along the bluffs of the Missouri river, in the northwest part of the State, and is, probably, a continuation of the same formation.

Nearly every locality in the district gives evidenee of identity, in the existence of small calcareous concretions and portions of shells.*

Little or no gravel was found, except in close proximity to the Mississippi and Missouri rivers; and but few transported boulders of any considerable magnitude. The largest, containing a cubic yard or more, lies on the surface near the railroad, on the summit between Castile creek and third fork of Platte river.

The deposit of loess exerts an important controlling influence in this district, for without it, the coal field that extends over half the area, would be a barren waste; for the shales and sandstone members of the Coal Measures are developed in the usual degree, and would produce the usual deleterious effect upon the soils. But no such effects are produced here; for this loess, rich in mineral fertilizng matters, covers those substances to such a depth as effectually to prevent them from mixing with the soil, except in limited localities.

It is not alone in the coal district that great advantages are derived from this deposit; but whatever pre-eminence this district, and probably North Missouri, generally enjoys in this respect, it is alone due to this deposit.

After the foregoing remarks, little is necessary to be said in relation to soils. The soil in all parts of the district is fertile in the highest degree, with slight modifications, requiring only a different mode of culture, and the products adapted to different localities, to produce equal results. Perhaps the preponderance may be in

* The Hon. George Monroe, of Livingston county, a gentleman of intelligence and veracity, informed me that, in sinking a shaft for a well near his residence, at Monroe's Bluff, elevated about three hundred feet above Grand river, a large quantity of shells, in a good state of preservation, were thrown up from a depth of forty feet below the surface, and with them a marl exceedingly rich in the elements of fertility. This locality rests upon the Sharpsburg sandstone.

favor of the limestone district, west of Grand river, especially when we take into consideration that the products best adapted to that region are those that now yield the greatest profit on the labor expended; but, should circumstances change that preponderance will be lost.

At some few localities in the district the soil is thin and heavy, in consequence of a superabundance of clay; but where it is properly tilled and the subsoil is in reach of the plow, so as to be brought up and mixed with the surface, it becomes friable and produces well. Such a soil is remarkably well adapted to the cereal products, maturing those plants without the addition of artificial stimulants, so apt to produce a redundancy of straw at the expense of a proper development of grain.

The soil in Macon county is remarkably well adapted to the production of a superior article of tobacco; also the upper portions of Chariton county, the higher portions of Linn, and the southeastern portions of Livingston, and also the upper portns not included in the limestone district.

These regions will become as famous for the production of tobacco as were the most favored portions of Virginia in her palmiest days.

There is yet another variety of soil deserving attention—the alluvial deposits of the valleys, usually denominated "Bottoms" in the West. This soil is necessarily deep, and of unbounded fertility, well adapted to the growth of Indian corn and hemp, but not to wheat and small grains, in consequence of its excessive fatness, or superabundance of organic matter.

In the valley of Grand river the bottoms vary from three to five miles in width, and are elevated from twenty to thirty feet above the bed, and above ordinary high-water mark. In the valley of Grand Chariton, the bottom lands are about equal in extent to those on Grand river, but not elevated so high above the bed of the stream, and are consequently more frequently inundated.

Timber usually exists in the valleys and along water courses of the usual varieties found in this State, and the West generally. The most abundant and valuable varieties are the different kinds of white and black oaks, black and white walnut, and occasionally a grove of maples (Acer Saccharinum.) The supply would be sufficient for domestic and agricultural purposes, if it were equally distributed; especially when we take into consideration the facilities the Hannibal and St. Joseph railroad will afford in distributing the products of the forest, and the coal-beds found along that line.

The Osage orange, too, is under extensive experiment here, and thus far promises well; and should success finally attend the rearing of hedges for fencing purposes, a small amount of timber will suffice this district.

It will be seen, by an inspection of the map, that this district is traversed by several rivers, with their branches diverging in every direction and watering the country in an admirable manner. The largest of these is Grand river, running nearly north and south through the centre of the district. The stream is navigable two months in the year for small steamboats (or those carrying eighty or a hundred tons) from its mouth up to the junction of the east and west forks, and for keel boats thirty miles higher up the east branch. The fall of the stream is less than a foot per mile. It runs over a muddy bed, except at Monroe's Bluff or rapids, where it passes over a limestone bottom.

Grand Chariton is next in size. The volume of water is perhaps less than half that of Grand river, and in almost in all other respects, the same. Salt river discharges less water than Grand Chariton, and differs from it by being composed of alternate pools and rapids. These streams will afford no other facilities to the business of the country than in creating water power, for which Salt river and its branches are well adapted. Several of the minor streams too, are well suited to that purpose, particularly Medicine and Shoal creeks. Many of the mill-sites on the streams are occupied by ordinary structures, with indifferent machinery; but on Platte river and its branches are a few miles supplied with modern improved appliances. At Utica, Livingston county, an establishment is now in the course of construction on an extended scale; and all things being considered, I should suppose that a sufficient amount of water power can be obtained on the several streams to supply the domestic wants for many years to come.

There is but little waste land in this district. This circumstance, with the exceeding fertility and durability of the soil, and its adaptation to the various products of this climate; its exhaustless beds of coal, and its salubrious climate, render this a favored district, and capable of sustaining a population as dense as any portion of equal extent in the northern temperate zone. And I can but express a gratification for the trust you confide in me, in assigning so important and interesting a field to my charge, and thereby connecting me in an humble way with the development of its resources.

There are, probably, but few portions of equal extent, where the geological or natural advantages of the country and internal improvements will react upon each other with such important results. I have been frequently impressed during the progress of my researches, with the great advantages that may accrue to the State as well as to individual corporations, by conducting geological investigations with the various lines of public improvements now in progress, or that may hereafter be undertaken, in various parts of the State.

ART. III.—CANTON COPPER MINE, CHEROKEE CO., GEORGIA.—By PROFESSOR JULIEN DEBY.

THE lands on which this mine is situated, comprehend lots Nos. 161, 162, 127, 128 of the 14th district and 2d section of Cherokee county, in the State of Georgia. The general strike of the strata in this whole region of country is from W. 52° N. to E. 52° S., and the general formation is talcose and choritic slates of the Azoïc series, or lowest metamorphic members of the Silurian system of rocks. These slates contain conformable veins and strata of quartz, and of granitic talc slate, hornblendic quartz, and tourmaline in quartz.

The copper veins are distinctly indicated at the surface of the ground by irregular outcroppings of porous hydrated oxyd of iron; this "gossan" contains shining particles of mica and minute grains of crystalline quartz. Three principal outcroppings of gossan are well defined on the hill top at not many yards from one another, and may be followed for more than a mile without interruption. On one of the veins a perpendicular shaft has been sunk to a depth of 145 feet; it has been well timbered, and has good ladders fitted from top to bottom, as well as a horse whim and buckets for the extraction of water and ore. A hand "fan" for ventilation is also constantly at work.

A first tunnel has been cut at a depth of 95 feet from the surface, and perpendicular to the direction of the shaft. At this point, the copper ore vein is cut by the works, it being here very small, varying in width from one to four inches, and walled at top and bottom by altered quartzo-talcose slates. This tunnel runs N. W. by W. 60°, and is 54 feet long. At the extremity of this tunnel, the dip (which is generally 45°) is locally nearly ten degrees greater than in other portions of the mine.

The second tunnel is in direct continuation of the first, on the opposite side of the main shaft, the floor being on the same plane with the above, and its course perfectly similar. In the roof of this tunnel, a vein of pyritous iron ore, slightly cupriferous, from 2 to 3 feet wide, and mixed with porous limonite, makes its appearance. Below this vein is found chlorite slate with galena, and above it an irregular vein of hydrated oxyd of iron, from 4 to 5 feet in thickness. This tunnel is 70 feet in length.

At 115 feet, the third tunnel has been dug out, and extends to a length of fifty feet. The small gallery leading from the shaft to this tunnel is cut through soft chlorito-talcose steaschist. A three inch vein of yellow pyritous copper ore cuts the tunnel at its point of junction with the small branch tunnel. At the apex, a vein containing some block copper, walled above and below with chlorito-talcose slate, is found. Above this vein, which is situated in a portion of the tunnel which is very slightly deflexed northward, is seen some fine "gossan," forming a vein about five

feet wide, intermixed with quartz and small portions of native copper, as well as galena. A small streak of gray copper ore is seen above the gossan.

The fourth tunnel is situated at 140 feet in depth. It communicates with the shaft by means of a gallery some 20 feet long.

The vein runs through the south wall and roof of this tunnel, forming a voluminous stratum 8–9 feet in thickness, and consisting in a compact mass of copper pyrites, galena, and some iron pyrites heterogeneously intermingled. The upper and lower walls are formed of steaschist. The showing of ore is best near the extremity of the tunnel.

The gossan which was so abundant in the third tunnel seems not to have prolonged itself to this depth, and to have "given out" in the intervening space between the two tunnels.

From the above, it will be seen that the metallic vein increases rapidly in width, at the ratio of nearly half an inch to the foot, and that the quality of the ore is in direct proportion to the distance of the mineral from the surface of the ground and the power of the vein.

The mine is situated on the crest of a long hill, averaging about 150 feet over the level of the neighboring valleys; it is situated at 1¼ mile from the town of Canton, on the Marietta road. By a careful examination of the hill side, two other well-marked veins of gossan are visible at the surface by their outcroppings, and we have no doubt but that under them will also be found corresponding veins of the more valuable metal. These veins will be cut through by the tunnel, which is being dug at the north foot of the hill, and which will intersect the shaft at a short height above its actual bottom. This same tunnel will also traverse three zones of talcose slate, with thickly imbedded garnets, and several veins of white quartz, which will most likely prove to be more or less auriferous.

The ores extracted from the Canton mine, very poor at the onset, have gradually increased in value as the vein was worked deeper. The copper is found principally in the shape of copper pyrites, with smaller portions of chalkopyrites and black and gray copper ores. Small specimens of blue vitriol (formed by the decomposition of the pyrites) of malachite and of dendritic native copper are not unfrequently met with. The lead exists as galena with occasional portions of crystallized acicular carbonate of lead and of pyromorphyte. This lead is argentiferous, and yielded to a hasty analysis by the humid way, 0·55 p. ct. of Si. Specimens of the copper ore furnished us with 24 p. ct. of Cu by precipitation, by means of K as Cu after separation of the iron by NH^3. The minerals found by us in this locality were: tourmaline, carbonate of lead, sulphuret of lead, carbonate of copper, sulphuret of copper, native copper, sulphate of copper, gray and black copper, iron pyrites, sulphate of iron, hydrated oxyd of iron, oligist,

magnetite, garnet, kyanite, hornblende, tremolite, talc, chorite, asbestus, quartz, ilmenite and rutile.

NOTE.—I believe this mine will prove to be among the most valuable in Georgia; it is owned by an enterprising and responsible company, which has taken the title of the "Canton Mining Company of Georgia," the Board of which is constituted as follows:—President, Dr. Thompson; Directors, G. W. Garmany, J. G. Rodgers, Dr. McIntyre, Judge Keith.

The works are energetically and most satisfactorily conducted by Dr. W. F. Harris, and we have no doubt but when the shaft shall have been sunk to a depth of 200 feet, a tunnel dug to the vein at this depth (and an engine placed over the works to master the influx of water), the ore extracted will pay well for shipment, and compare well with the best product of the Ducktown mines.

We base the preceding assertion on the following facts:

1. The ore, even now, at Canton is as rich in per centage of copper as that from Ducktown, and is more compact and portable.

2. The freight from Canton to Marietta, on a first-class road (distance 20 miles) to the railroad will be so low that the Canton ore will reach the northern smelting establishments at a comparatively small cost.

3. Provisions of all kinds for men and teams are good, cheap and abundant in Cherokee, Georgia.

4. Wood and water are plentiful and "handy" on and around the Canton Mining Company's lots of land, and would warrant, at some future day, the establishment of smelting furnaces.

5. The proportion of silver in the Canton ores is considerable.

Such are the principal motives which induce me to predict for the Canton copper mine a prosperous future and a rich harvest for its owners.

I hope this very incomplete report will prove satisfactory. The short time allowed me for the examination of the locality will serve as an excuse for its shortness and deficiency.

You will find accompanying, a sketch of section of the mine as it now stands.

JULIEN DEBY.

ART. IV.—THE PRIDEVALE IRON COMPANY'S PROPERTY.—By P. W. SHEAFER.

GENTLEMEN:—Having completed an examination of your estate, I herewith transmit the result for your consideration.

I would observe that I have incorporated several things which can present no information to you. Presuming, however, that my report would come under notice of others not so well acquainted with the property, it seemed advisable to combine the whole in a connected description for the advantage of those who may desire to inform themselves of the characteristics of this estate.

Its appears desirable to present an economic report, exhibiting the value of the land in a business aspect, rather than to attempt a minute description of the purely geological features of the various beds of coal, iron ore, and limestone.

Much time and labor would have been necessary to identify, upon different parts of the property, the numerous mineral strata; and, when finished, the work would still have left the business man at a loss to make a proper use of the data. We may, therefore, omit the notice of several beds of ore and coal which are of little economical importance, and a knowledge of which is chiefly of scientific interest in relation to the nature of the geological formations.

Had it been necessary to enter upon a strictly scientific and detailed description of the mineral wealth of your Property, it would have been difficult to add much to the results obtained by Professor W. B. Rogers, who, some time since, submitted an elaborate report upon the same subject. My attention has, therefore, been especially directed to the commercial relations of the question, and the economic development of the property. In order to meet this demand, I have done little more than to follow the most valuable of the veins described by Professor Rogers, and to search for them in localities where their position gives them a peculiar importance—to consider the various economic conditions which must be satisfied, in order to realize the greatest practical result—in short, to study the business aspects of the property, and to suggest what seemed the most harmonious grouping of its prominent industrial features.

OF THE LOCATION OF THE PROPERTY.

The Pridevale Estate contains some 14,000 acres of land, situated in the great Bituminous Coal Field in Monongalia and Preston counties, North Western Virginia. It is located on the waters of Cheat river, about six miles south of its confluence with the Monongahela, in South Western Pennsylvania. The Property is distant from Baltimore 327 miles—302 miles by the Baltimore and Ohio Railroad, and 25 miles by daily Stage Coach; the distance in time is 18 hours. The distance in time from Philadelphia is 22½ hours, and from New York 27 hours: from Wheeling the distance is 8 hours, and from Pittsburgh 17 hours; this latter route is by steamboat to Brownsville, along the line of the "Monongahela Navigation;" thence 30 miles by stage coach to Pridevale. The communication will be facilitated by the completion of the Railroad from Greensburgh on the Pennsylvania Railroad to Uniontown, about 16 miles distant from Pridevale. The Connelsville Railroad, now rapidly approaching completion,* passing some miles to the north of Uniontown, connects with the improvements of the Youghiogheny river, and also goes direct to Pittsburgh. Upon the eastern side it passes through Southern Pennsylvania. But the most important improvement is the Slack

* Completed and opened 12th September, 1855.

Water Navigation of the Monongahela river, which will shortly furnish a steamboat communication between the Southern Pennsylvania State Line and the City of Pittsburgh, thus bringing the Pridevale Estate within six miles of steamer navigation. The improvement of Cheat river by Slack Water Navigation, within the limits of your property, would be an enterprise which the Monongahela Company should encourage in a very effective manner, for that work would derive no inconsiderable revenue from the trade of your district, were your lands developed to the extent of their productive capacity. It is expected that the completion in the present year of Dams No. 5 and 6 of the Monongahela navigation, will extend the slackwater to New Geneva, 28 miles above Brownsville, and by the construction of another Dam it will reach to the State Line. For a full understanding of this subject the reader is referred to the 15th Annual Report of the Monongahela Navigation Company.

The distance of Pridevale from Pittsburgh by the river is then as follows:

From Pridevale to the State Line	6 miles
From the State Line to New Geneva	7 "
From New Geneva to Brownsville	28 "
From Brownsville to Pittsburgh	60 "
Total from Pridevale to Pittsburgh	101 miles.

Such a line of transportation by water is an undoubted advantage. The Schuylkill Navigation, terminating at Philadelphia, is 108 miles long, and maintains also cars for the transportation of Coal by Railway for a distance varying from 5 to 20 miles; this work carries a large portion of the Anthracite Coal trade of Pennsylvania.

OF THE GENERAL FEATURES OF THE LAND.

The Pridevale Tract is situated in a picturesque country, upon the western slope of the Alleghanies; the Cheat river passes through the property in a beautiful valley which is above the reach of floods. A Dam has been constructed at the southern part of the river shore, from which the Rolling Mill and other improvements are supplied with water-power.

The soil is a rich vegetable mould, finely adapted for agriculture, and produces full crops of wheat, corn, oats, &c. About one thousand acres are now cleared, fit for cultivation, and the rest consists of an undulating woodland covered with timber; the principal varieties of trees are the oak, chestnut, poplar, beach, and maple. The hills are well suited for the grazing of cattle and rearing of sheep. Beneath the surface are valuable deposits of iron ore, coal, limestone, and fire clay, of which we shall presently treat in detail.

OF THE PRESENT IMPROVEMENTS.

Of the Furnaces.—There are three Blast Furnaces—the *Anna*, the *Woodgrove*, and the *Henry Clay*.

The *Anna* Furnace is situated on Cheat river; it is blown by steam-power, and has all the most recent approved improvements; it is a Charcoal Furnace, and its capacity for making iron is 70 tons per week.

The *Woodgrove* Furnace is about a mile from the river, upon Middle Run. This is a Charcoal Furnace; its capacity is 40 tons per week; but, with judicious improvements, which can be effected at a small cost, this capacity can be increased.

The *Henry Clay* Furnace is about three miles from the river. Upon the completion of the projected improvements which were explained to me, there is no doubt that its capacity would be equal to 60 tons per week.

It seems that a make of 140 tons per week, which will be realized from the *Anna* and *Woodgrove*, would be sufficient for a regular business until the Company is prepared to enter upon very extended operations.

The water-power created by the Dam above mentioned has been employed for the purposes of a grist mill, saw mill, foundry, trip hammer, refinery, nail works, rolling mills, &c. These various works are advantageously placed along the line of a canal of 900 feet in length, and which could be extended half a mile further north, the nature of the ground being favorable. The Rolling Mill is 98 feet by 48 feet, with a very large adjoining building; it contains eight pairs of rolls of various patterns, adapted for rolling bar, sheet, and rod iron; lathes and three pairs of shears, together with puddling and boiling furnaces. As it has been idle for several years, it would require considerable repair; but it can be put in good working order at a moderate cost, should it be deemed expedient to work up the pig iron made by the furnaces.

The whole of the immense water-power of Cheat river could be applied to the propulsion of mills of various kinds, for which the valley offers very favorable sites; the supply of water in the river is unfailing, and subject to very little variation. The iron furnaces, however, cannot be advantageously operated by water, their location being determined by many other considerations; but for all the purposes of manufacturing, where water-power is desirable, it is here to be had in abundance. Colonel Ellwood Morris, C. E., in 1848 estimated the total water-power leased by the Schuylkill Navigation Company at the Town of Manyunk, so well known for its cotton manufactories, at the gross sum of 300 horse-power; but the water-wheel at the Pridevale Rolling Mills alone is estimated at 200 horse-power. It appears to me that besides the saw mill, which the Company maintains for its own

purposes, this valley would afford a good location for a mill upon a large scale to prepare lumber of all descriptions for exportation.

There appears no reason why a heavy trade, from that in sawed lumber to that of wheel felloes, spokes, chair frames, and articles of turned wood, could not be established at this point; there must be a demand both in the surrounding country and along the line of Monongahela river, and well-directed enterprise could even enter the Pittsburgh market.

OF THE IRON ORES.

As already hinted, it seems expedient to consider the present industrial capacities of the Estate, rather than to attempt a detailed geological arrangement of all the *various ores*, *coals*, *limestones*, and other strata with the accessory rocks and slates; the cross section prepared by Professor Rogers is sufficiently minute.

Upon viewing the Cross Section, we at once perceive an important feature of this tract, namely, the great thickness of the stratification through which the various minerals are deposited, from the *massive blue limestone* up to the *seven feet coal vein*, making in all a thickness of over 1000 feet.

But this great size of the measures would not be fully available were it not for another equally favorable geological characteristic, the gentle dip of the strata, which exposes them along a line of about two miles in length on the banks of Cheat river. This great natural feature, which peculiarly belongs to your property, indicates the most favorable location for mills and machinery, for mining and quarrying coal, ore, and limestone, for cutting wood and coaling, the roasting of ores, and the preparation of your products near to their point of shipment, because the descent of 20 feet in the river is a fortunate circumstance, advantageously adapted to all the requirements of these objects.

For an analysis of the ores, I refer you to the annexed report, by Professor Booth, Assayer, U. S. Mint, at Philadelphia, of whose reputation as a chemist it is unnecessary to speak.

ORE GROUPS.

I. *Martin Group.*—The beds of this group are extensively laid bare on the high grounds of the Laurel Hill range; they are thus exposed on Quarry Run, which flows by the Henry Clay Furnace. The Martin Ore, along part of its outcrop, has never been mined, and could be favorably reached by stripping and shallow benching.

II. *The Stratford Group* is well exposed on Middle Run, and for a distance of two miles between this and the old Stratford Mines, there is ample room for mining, both by benching and by drifts. From the general good quality of the layers, the Stratford Ores will, in all probability, be found to hold a fair average as to quantity and quality.

III. *The Norris Group.*—The Ashby Ore has been pretty extensively opened by benching on the south side of Middle Run, from a quarter to half a mile from Woodgrove Furnace. This benching can be extended. The proximity of these exposures to the Furnace is an advantage which should be duly considered.

IV. *The Haines Group.*—The lowest bed of this group can be reached in numerous localities along its outcrop from the Anna to Woodgrove Furnace. The Snake-Den bed has been benched upon the hill next westward of the Woodgrove Furnace; it has been traced on Middle Run half a mile below the Furnace, and has again been seen within a like distance of the Anna Furnace. This Ore much resembles the Scott Ore, which is said to be very productive. It evidently belongs to the same range of strata.

V. The Big Coal Group.—The beds of this group are among those which have generally been considered as the least important of the Pridevale Ores; but the recent discovery of a heavy deposit of excellent Ore, under the Coal, near Woodgrove, shows that we should be cautious in altogether neglecting any seam as valueless. This Ore can be mined and delivered at Woodgrove very cheaply. There is great probability that it can be traced all the way to Anna Furnace, and should analysis show it to be of a quality equal to that which is indicated by its appearance, it will prove of great value.

TABULAR ARRANGEMENT OF THE GROUPS, AND ANALYSIS OF THE IRON ORES OF THE PRIDEVALE ESTATE.

Name of Group.	Name of Ore Bed.		Per Centage of Iron.
Big Coal Group..	3. Oliphant............	Ore..............	
	2. Vermilion...........	"	56.49
	1. Knotty Rock.........	"	56.91
Haynes Group...	3. Snake-Den...........	"	
	2. Haynes.............	"	51.90
	1. Utt................	"	48.80
Morris Group...	5. Swisher............	"	
	4. Ashby..............	"	
	3. Clellan............	"	
	2. Limestone..........	"	
	1. Norris.............	"	43.75
Stratford Group	4. Coles' Blue Flag......	"	50.00
	3. Black Band.........	"	
	2. Stratford..........	"	38.11 41.30
	1. Carr or Zebra.......	"	25.83
Martin Group...	5. Flag...............	"	
	4. England or Rock.....	"	56.91
	3. Flint Hematite.......	"	57.68
	2. Martin.............	"	43.43
	1. Red Belt............	"	

We have here presented a synopsis of the most important beds of the several groups; such of the Ores therein designated as are accompanied by a statement of the per centage of Iron as contained per chemical analysis, are those which, for apparent richness and for availability, have seemed to me of most consequence; but the reader would err who should suppose that it is designed tacitly to admit the entire want of economic value in all the Ores which have not been analyzed. It is true that some of these, by reason of their apparent defect of metallic contents, do not call for an analysis, or that from too great mixture of foreign material with really rich Ore, from irregularity or the scattered nature of the beds, or for difficulty of access where now known, these seams cannot be fairly offered as a solid basis for business enterprise, but it is well to bear in mind that the exploration over such a large tract has not been, and cannot be perfect. The contingency of such a discovery as that just made in the Big Coal Group cannot be deemed improbable, much less impossible, on an estate so rich in Ores. The disappearance of an unfavorable feature, when some of the beds shall be traced in new localities, is a circumstance also of frequent occurrence in geological experience. Other difficulties may be modified or removed with the development of the property. On the whole, it may be fairly claimed that the character of the inferior Ores does not warrant a distrust of the others after analysis; but that, on the whole, for the reasons just assigned, it *does really enhance the value of the estate.*

By reference to the table, it will be seen that the average per centage of metallic Iron contained in the Ores is about 50 per cent. In the words of Professor BOOTH, "in point of richness, therefore, nothing more can be desired; * * * most of the Ores containing appreciable qualities of Alumina, are thereby rendered more easy of fluxion in the blast furnace." The Blue Flag Ore of the Stratford Group, he considers a *very valuable Ore;* its earthy matter also promotes fluxion. Professor BOOTH's analysis will be found in full annexed to this Report, for the benefit of those readers who desire to know the details upon which the above cited opinions are founded.

OF THE COAL VEINS.

There are upon the Estate some twelve or thirteen Coal veins, of which *five* possess considerable economic value; namely, the *Five feet vein*, the *Two and a half feet vein*, the *Seven feet vein*, the *Blacksmith vein*, and the *Norris vein*. Their position is shown upon the accompanying Section. The most important of these is the

FIVE FEET VEIN,

which is superior to any of the others for several prominent rea-

sons, although in some of the others counterbalancing advantages are obtained to a certain extent.

1st. *Its quality* is equal to that of any other Coal in the district. Professor Booth says, "The Coal can evidently be employed in the blast furnace; but how large a proportion, or whether all of it can be used in the raw or uncoked state, I cannot determine. * * * It yields about one third gaseous matter, and leaves two thirds Coke." He recommends the use of Coke and raw Coal together, increasing the quantity of raw Coal, as experience may dictate, so as finally to dispense with coking altogether, should this be possible; the experiment has been successfully tried in Ohio, and no apparent obstacle prevents a like desirable result in this instance. Professor Booth candidly declines to speak of the value of the Coal for gas purposes; but I am pleased to be able to state that the Fairmount Coal, which is found only twenty miles from Pridevale, and is the same vein, is extensively used in Trenton, New Jersey, for the manufacture of illuminating gas, and that it yields the very large quantity of 4½ cubic feet of gas per lb. of Coal. The Fairmount Coal is sold there for $7 per ton, and is pronounced equal to Pittsburgh Coal.

2d. *Its thickness* is of that medium degree which experience has shown to be conducive to cheap mining, because, in order to penetrate a Coal bed by galleries of convenient size, it is frequently necessary to remove a considerable portion of the containing strata; or, on the other hand, in order to secure a safe and permanent roof, where the vein is very large, it is either necessary to support it with timber, or to excavate passages of inconvenient dimensions; but here a gangway, or a breast of five feet high, exhausts the Coal, and leaves a perfectly safe roof of compact slate, which will be supported securely, if proper pillars be left in working, and which will rarely need any timbering. The vein contains but little dirt, and may fairly be styled a five feet vein. The floor is composed of a bed of *fire clay* six feet thick, of excellent quality, so that, as fast as the Coal is mined, some three feet of this material can be taken from the bottom of the breasts, at a small additional cost. A light seam of Cannel Coal, 1½ inches thick, overlies the Coal.

3d. *Its proximity* to the River, to the Anna Furnace, the Lime Kilns, the Fire-Brick Kilns, and the Village.

4th. *Its quantity.* The area underlaid by this Coal may be considered about 1,000 acres, which is, undoubtedly, ample for the purpose of Iron making. The fortunate discovery of the five feet vein in the vicinity of the Anna Furnace, renders practicable an important economy in the delivery of the Coal. A tramway of some 500 yards in length may be laid to the mine on a level with the tunnel head of the Furnace, if the vein be opened at the point indicated by my exploration. There is ample room about

the head of the Furnace, to give facilities for coking, or any other preparation of the materials for charging the Furnace. Formerly the Coal was hauled from the Big Vein in wagons, for which purpose it was necessary to maintain expensive teams. The same tramway will deliver Coal for the use of the operatives, cheaper than they can cut wood, for fuel. The Lime Kilns and Fire Brick Kilns can also be supplied with Coal by the same road. Ths cost of mining the Coal can be set down at one cent per bushel, or 30 cents per ton, and the cost of delivery at the Furnace at five cents per ton additional.

THE TWO AND A HALF FEET VEIN

is the next in importance, at least in connexion with the present development of the property; from this Vein the Woodgrove Furnace can be most cheaply supplied with Coal, by opening the Vein at a point indicated within about 400 feet of the furnace; and here, also, a tramway should be constructed, which would save the present expensive haulage of 1½ miles.

THE SEVEN FEET VEIN AND OTHERS.

The two Veins just mentioned will supply all the Coal required for the manufacture of Iron; but should a favorable market be found for Coal from this district, the seven feet Vein and the other beds mentioned may be worked.

The seven feet and underlying veins may also be opened within a reasonable distance of the Woodgrove Furnace. As these are the same as the Fairmount Coals, which are highly esteemed for gas making, and are transported for that purpose some 300 miles by railroad to Baltimore, and thence to Philadelphia and New York, it is not improbable that your Coal may in time find a profitable market, although existing improvements, and the present course of trade, do not enable you at this time to offer it for sale. It appears, however, that you may reasonably expect a local demand to arise as the resources of Western Virginia are developed.

OF THE LIMESTONE AND FIRE CLAY.

The *Limestone* is the lowest of the mineral strata upon the Pridevale Estate, the most important bed being that which lies under the Big Vein of Coal; it is opened North of the Woodgrove and Anna Furnaces, within reasonable distance. The best exposures are along Cheat River, which locality, as has been stated, is conceived to be the proper one for mining operations. Professor BOOTH considers this Limestone to be of good quality for fluxing Iron Ore, and the total available material for fluxing is, by his determination, 84 per cent.

The Fire Clay has already been spoken of in connection with

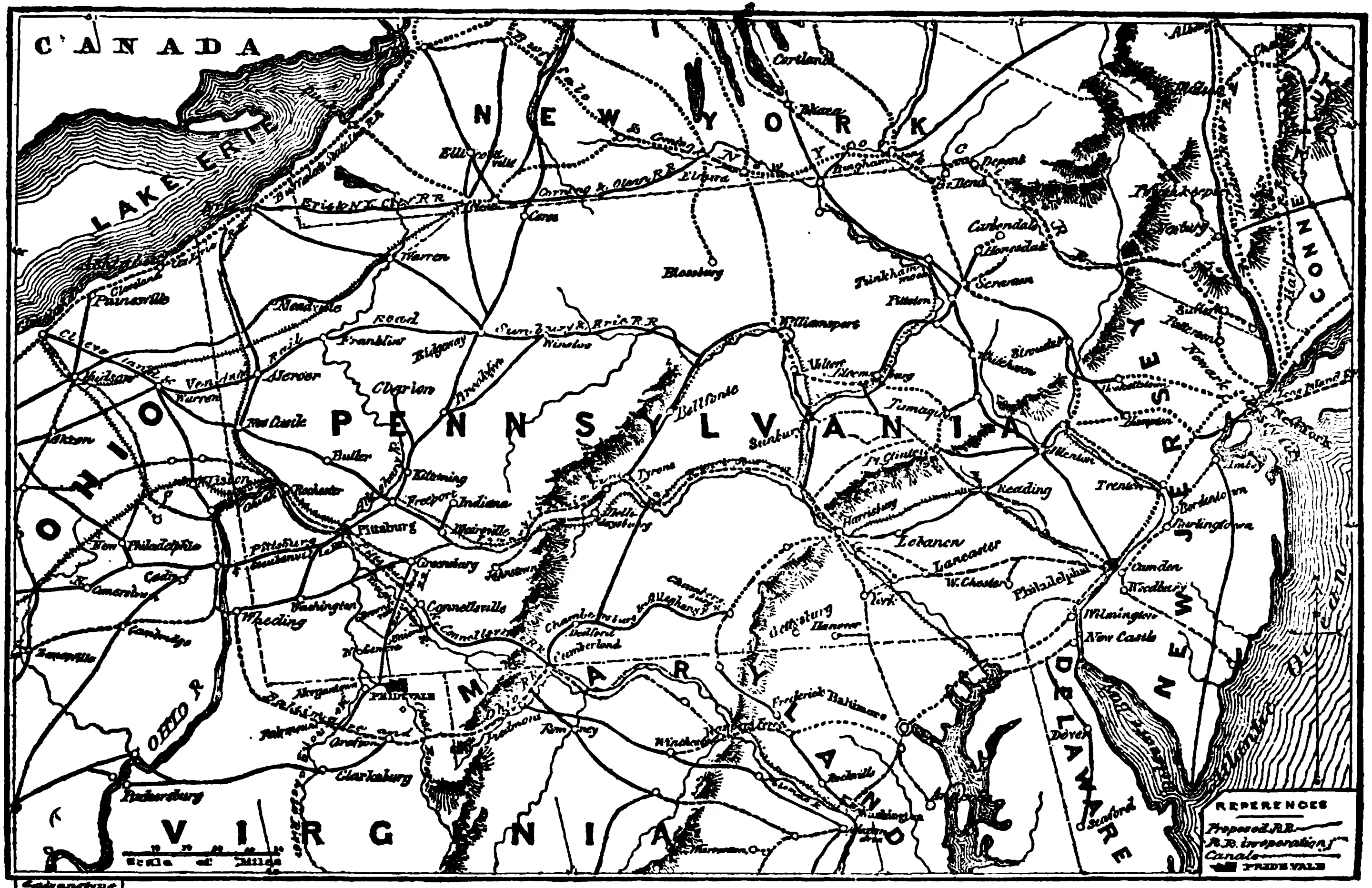
the five feet Coal Bed. There are several veins of Fire Clay among the Coal, but that mentioned above is so large and so easily mined, as to render further allusion to the subject superfluous. The advantages of a supply of this material, both for the use of the Iron Works and Blast Furnaces, as well as for the manufacture of Brick for exportation, are apparent.

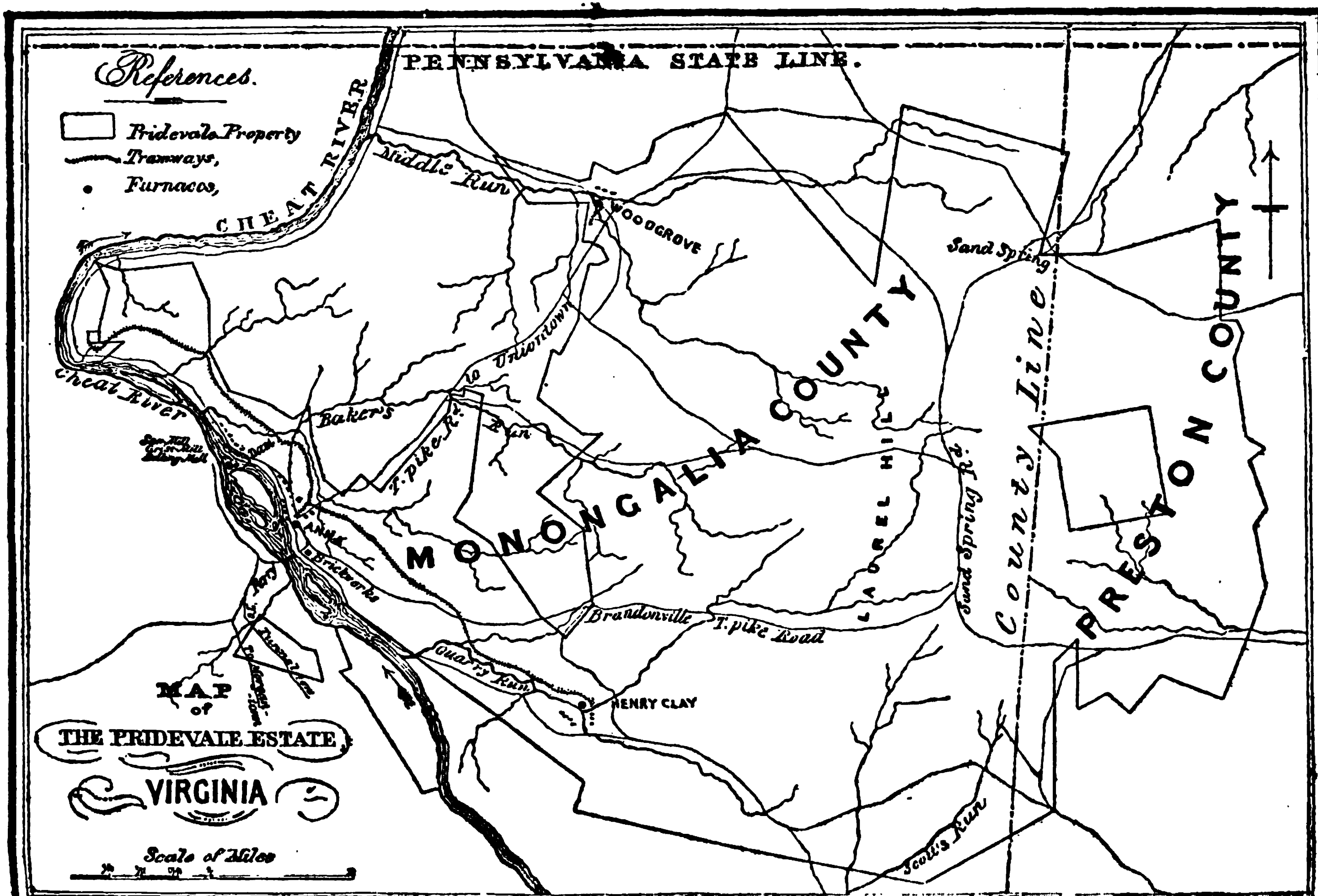
From the very deep cut which is made by the Cheat River in the strata of Laurel Hill, a better opportunity of access to the lower lying Veins of Ore, Coal, and Limestone is afforded upon your Estate, than in most parts of the adjacent country; this fact will appear the more striking, if we consider the advantage derivable from boating the Ores, Limestone, and Coal down Cheat River, from the favorable spots offered for mining and quarrying; by which means, an easy and cheap transport to the Furnaces can be found. In the same manner, it will be found advantageous to cut the timber for coaling, along the steep banks of the river, to coal it at the foot of the hills, and transport it upon the water.

I will only here repeat, that it is in the exposures of the valley of Cheat River that the proper points of access are to be found to the mineral treasures of this estate. The subject is alluded to in several portions of this Report, and I now dismiss it with the emphatic declaration, that it is, in my view, an important natural advantage of this tract, which has not received the attention it deserves.

GENERAL REMARKS.

I have now spoken in detail of the various products of your Estate, and have expressed the conviction that they are of a character to render this a valuable property for the making of Iron, for Agriculture, and for the transaction of various kinds of business. I have not yet expressed myself definitely as to the management of the Furnaces, because, in bringing into action all the resources of a large estate like this, which as a whole, and in its several parts, seems to offer profitable modes of improvement, much must be left to the suggestions of experience and to the indications of the times. It has, however, appeared to me that, for the present, it will be your policy to make your Iron largely with Charcoal. This kind of Iron must always be in demand, and it is important to clear your lands for agricultural purposes. Should you sell extensively to immigrants, they would, no doubt, be willing to deliver the timber for Charcoal, or to make the article at a very low price. With regard to the making of Iron with Coal, it has been observed that this has been accomplished at Massillon, Ohio, and elsewhere, and there seems no reason why the Pridevale Coal would not answer equally well for this purpose. Professor BOOTH's analysis certainly does not oppose this view, while analogy sustains it.


CANADA
LAKE ERIE
NEW YORK
PENNSYLVANIA
OHIO
MARYLAND
VIRGINIA
DELAWARE
NEW JERSEY
CONN
Cleveland
Painesville
Meadville
Warren
Erie
Franklin
Mercer
Clarion
Ridgway
Brookfin
Sunbury & Erie R.R.
Winslow
Williamsport
Bellfonte
Tyrone
Pittsburg
Butler
Kittaning
Freeport
Indiana
Rochester
Greensburg
Johnstown
Connellsville
Washington
Wheeling
New Philadelphia
Cadiz
Cambridge
Zanesville
Akron
Hudson
Warren
New Castle
Ellicottville
Corning & Olean R.R.
Elmira
Binghampton
Blossburg
Cortland
Ithaca
Carbondale
Honesdale
Scranton
Pittston
Stroudsburg
Allentown
Reading
Harrisburg
Lebanon
Lancaster
W. Chester
Philadelphia
Camden
Trenton
Woodbury
Wilmington
New Castle
Dover
Seaford
York
Hanover
Gettysburg
Chambersburg
Bedford
Cumberland
Frederick
Baltimore
Rockville
Washington
Winchester
Romney
Clarksburg
Parkersburg
Fairmont
Grafton
Morgantown
Uniontown
OHIO R.
Mt Carbon
Alexandria
Warrenton
Burlington
Bordentown
Newark
Paterson
New York
Poughkeepsie
Albany
Hudson
Scale of Miles
REFERENCES
Proposed R.R.
R.R. in operation
Canals
Galvanotype


MAP
of
THE PRIDEVALE ESTATE
VIRGINIA
Scale of Miles
References.
Pridevale Property
Tramways,
Furnaces,
PENNSYLVANIA STATE LINE.
CHEAT RIVER
Cheat River
Middle Run
WOODGROVE
to Uniontown
Baker's
T.pike Rd.
Run
MONONGALIA COUNTY
LAUREL HILL
Sand Spring
Sand Spring Rd.
County Line
PRESTON COUNTY
Brickworks
Brandonville
T.pike Road
Quarry Run
HENRY CLAY
Tunnel Run
Scott's Run

It would be well to dispose of, for farms, all the land which is not required for the business of the Company. If you encourage the immigration of farmers by reasonable prices, their industry will secure the means of cheap subsistence for the operatives employed by you, and the wants of the farmers will draw to your property others who may profitably pursue their various occupations.

It is better to encourage, by liberal dealing, the rapid development of your estate, than to endeavor to monopolize all the subordinate branches of business, and thus to form a large and complicated enterprise, for which it will be both difficult and expensive to secure an efficient organization. It would be well to offer for sale mill seats and water privileges along the river, for Western Virginia must soon feel the stimulus of manufacturing industry; and your proximity to Pittsburgh and Wheeling, the emporia of Western commerce, is sufficiently favorable to command attention from those desirous of entering into such branches of manufacture as need not be necessarily located in the metropolis. Western Virginia is fast increasing in population, as appears from the census returns. In the ten years from 1830 to 1840, the whole population of this part of the State increased $14\frac{1}{3}$ per cent., and in the succeeding ten years it increased $30\frac{2}{3}$ per cent. The area of Monongalia County is 630 square miles; in 1850 this County produced 184,379 bushels of corn; 52,370 bushels of wheat; 111,252 bushels of oats; 6,013 tons of hay; 145,178 lbs. of butter. The population was 12,387, of whom 12,211 were free. In the neighboring counties of Pennsylvania, there were, in 1850, in Fayette County, 4.5 per cent. of the population black, and in Washington County 3.6 per cent.; in Monongalia County, as above, we find only 1.4 per cent. of colored population.

There can, then, be no objection to immigration of free persons from Pennsylvania, and the quality of the land is equal to that of the farm land in the neighboring parts of that State. For wool-growing, also, this part of Virginia is, by its climate, as well adapted as the adjacent counties of Pennsylvania, in which, according to the last census, the following quantities were produced annually:

Washington County	983,167 lbs.
Green County	135,565 lbs.
Fayette County	102,604 lbs.

It appears certain that the North Western counties of Virginia will share in this as well as other advantages, whenever they shall be brought within reach of the markets. That time is now commencing, and with the completion of the navigation from the Pennsylvania State Line it will have fully come. The connection of Pridevale with Pittsburgh by a cheap navigation seems to offer all that can reasonably be desired in the way of market.

facilities, although, as has been observed, there are other connections already finished or in progress of construction. The City of Pittsburgh must remain the great depôt of trade on the headwaters of the Ohio, and especially must it continue to be the grand centre of the iron interest; the metal in various forms must be exported from this point, to supply a rapidly increasing demand; and when the city is fairly brought into connection with the surrounding country, it can have no rival in many important branches of trade. Whatever is concerned with the manufacture or sale of iron, steel, coal, salt, and other products of Western Pennsylvania and Virginia, will seek the Pittsburgh market.*

In 1850, the population of Alleghany County was 138,098, and of the city and immediate vicinity, 83,000. There were within the county 1,267 manufactories, in which was invested a gross capital of $10,855,194. The dockyards and foundries of Pittsburgh turned out one new steamboat a week; the city contained 15 rolling mills, capable of making annually 49,200 tons of bar, rod, hoop, sheet and boiler iron, bar and sheet steel, nails and spikes. The production of steel alone in 1850 was 6,078 tons; the conversion of this material from the iron gave employment to 15 furnaces. The manufacture of nails occupied 205 machines, whose daily production was 1,000 kegs, or over 10,000 tons per annum.

The pig iron consumed in Pittsburgh is furnished from various parts of the surrounding country, and is again distributed in all directions after being manufactured. With such a market, there is strong encouragement for enterprise in any of the great branches of staple production; and, with the favorable location of your Estate, the facilities for transportation, the supply of raw materials, and adaptation to subordinate occupations, it must be considered as possessing great natural advantages.

I can, then, in conclusion, only say that in the Pridevale Estate you have a large tract amply supplied with many important

* The exports from the City of Pittsburgh in the articles of merchant bar iron and nails, amounted in 1854 to $7,500,120. Besides these articles of iron, there were castings, $700,000; stoves, $300,000; springs and axles, vices and spring steel, $566,000: shovels, forks, picks and axes, &c., $390,000; locks, latches, scales, &c., $350,000; iron safes, $60,000; steam-engines (exclusive of those placed in boats there), sugar and cotton mills, &c., $500,000; total, $10,366,00; all manufactured there.

Of bituminous coal, 23,738,906 bushels, worth $3,000,000. The aggregate value of the various articles manufactured at Pittsburgh during the year 1854, was $20,970,338. Value of lumber sent down the river, $1,225,000; total tonnage, 1,638,160.

The number of arrivals and departures at the port annually, make an aggregate of 8,576. During the year 1854 the aggregate tonnage of boats built was 18,207 tons (consuming 28,000 bushels of bituminous coal every twenty-four hours), at a cost of $1,553,338.

elements of wealth, which it is rare to find united upon one single property in such concurrent and harmonious distribution. *You have cheap and efficient transportation; there are ores, coal, limestone, fire clay, wood, and a fertile soil; and, under judicious management, your property must, in my opinion, prove one of great value, and eminently deserving the attention of those who may wish to enter into the business for which it is so well adapted.*

The following are the results of the assay by Professor J. C. Booth.

Having completed my examination of the various specimens of ores, limestones and coal from the lands of the Pridevale Iron Company, I herewith present the results of analysis:

Name of Ore or Locality.		*Per Cent. of Metallic Iron.*
Flint Hematite	Ore	57.68
Rock or England	"	56.91
Red (Vermillion)	"	56.49
Haynes	"	51.90
Coles' Blue Flag	"	50.00
Utt	"	48.80
Norris	"	48.75
Martin	"	48.48
Stratford Suggans	"	41.80
Woodgrove	"	39.69
Black Plate	"	38.81
Stratford Flag	"	38.11
Carr's Zebra	"	25.83

The average of all the above ores in their crude state, is 45.59 per cent. iron, and omitting the last one, it is 47.24 per cent. It being known that the best working average of iron ores is from 45 to 55 per cent. of iron, the above return of the crude ores is sufficient to place them in comparison with the best class of ores. But some of the ores belong to the clay-iron stone, or earthy carbonated ores, and hence the analysis of the crude ore does not convey a fair view of its richness. Thus, "Black Plate Ore," yielding only 38.81 per cent. iron in the crude state, loses so much carbonic acid by roasting, that it would become an ore containing over 50 per cent. of iron, if subjected to roasting previous to its being charged into the furnace. The same remarks apply to several ores in the above table. Hence, since such ores are usually subjected to a preliminary calcination, the true average of the above table of all the ores will be at least 50 per cent. In point of richness, therefore, nothing more can be desired. I may remark, in conclusion, that most of the ores containing appreciable quantities of alumina, are thereby rendered more easy of fluxion in the blast furnace.

The five feet vein of Pridevale Coal consists of

Volatile matter	32.50	
Fixed Carbon	55.65	67.50 per cent of Coke.
Ash	11.85	
	100.00	

In other words, it yields about one-third gaseous matter, and leaves two-thirds coke. The coal can evidently be employed in the blast furnace, but how large a proportion, or whether all of it can be used in the raw or uncoked state, I cannot determine. The analysis further indicates a sufficient amount of volatile matter to be employed in the manufacture of illuminating gas, but the comparative value of it for this purpose can only be determined by an express gas-making test, and photometric experiments on the gas.

Of the two limestones examined—that "under the Big Vein" and the "Lower Limestone"—the composition is as follows:

	1. *Under Big Vein.*	2. *Lower Limestone.*
Carbonate of Lime	80.70	80.88
Carbonate of Magnesia	4.75	1.87
Alumina and Oxide of Iron	4.10	1.55
Silica	10.45	15.70
	100.00	100.00

No. 1 contains about 90, and No. 2 about 85 per cent. of fluxing matter; but the Silica in No. 1 consumes, say about 6 per cent. of fluxing matter, and No. 2 about 9 per cent.; there remains of material, available for fluxing the ores in No. 1, 84 per cent., and in No. 2, 76 per cent. No. 1, or that under the "Big Vein," is, therefore, superior to the other for this purpose.

On reviewing the whole analysis, I am surprised at the variety and richness of the ores, together with the quality of coal and limestone, presented in the tract of the Pridevale Iron Company.

ART. V.—IMPROVEMENT IN THE TREATMENT OF CERTAIN BITUMINOUS MINERAL SUBSTANCES, AND IN OBTAINING PRODUCTS THEREFROM.* By JAMES YOUNG, of Manchester. Patent dated October 17, 1850.

THIS invention consists in treating bituminous coal in such manner as to obtain therefrom an oil containing parafine (which the patentee calls parafine oil), and from which oil parafine is obtained. The coals best fitted for this purpose are such as are usually called parrot coal, cannel coal, and gas coal, and which are much used in the manufacture of gas for the purpose of illumination, because they yield, upon distillation at a high temperature, olefiant and other highly illuminating gases in considerable quantity; and although some of the coals last described contain a large amount of earthy matters, those matters do not interfere materially with the performance of this process. To obtain parafine oil from coals, the following is the method of procedure: The coals are to be broken into small pieces, and are then to be put into a common gas retort, to which is attached a worm pipe passing through a refrigerator, and kept at a temperature of about 55° Fahr. by a stream of cold water. The temperature of the refrigerator should not be made too low, lest the product of the distillation should congeal and stop up the pipe. The retort being closed in the usual manner, is then to be gradually heated up to a low red heat, at which it is to be kept until volatile products cease to come off. Care must be taken to keep the temperature of the retort from rising above that of a low red heat, so as to prevent as much as possible the desired products of the process being converted into permanent gas. The coke or residue may then be withdrawn from the retort, which, being allowed to cool down below a visible red heat (to prevent waste of the fresh ma-

* From the Mechanics' Magazine, April, 1851.

terial to be introduced), may be again charged with a quantity of coals to be treated in the like manner. The crude parafine oil distilled or driven off from the coals as a vapor, will be condensed into a liquid in passing through the cold worm-pipe, from which it will fall into a vessel which must be provided to receive it. Instead of obtaining the whole of the parafine oil by distillation, a portion of it may in some cases, if thought desirable, be run from the retort (through an opening and a pipe provided in the anterior and lower part of the retort for that purpose) after it has separated from the coal and assumed a liquid form. The patentee prefers, however, in every case to distil or drive off the whole of the parafine oil to be obtained from the coal. The production of the desired products from a charge of coals in a retort will be known to be finished by the liquid ceasing to run from the worm. The crude product of this process is an oil containing parafine, which the patentee calls parafine oil. This oil will sometimes, upon cooling to a temperature of about 40° Fahr., deposit parafine. Other arrangements of apparatus may be used for subjecting coals to the process for obtaining parafine oil therefrom, but that above-mentioned is preferred as being well known and easily managed. But in order to obtain the largest quantity of crude parafine oil from coals by means of this process, and produce the smallest quantity of permanent gas by the action of the heat employed, whatever may be the apparatus used, care must be taken to heat the coals gradually, and to apply the lowest temperature necessary to complete the operation. During the distillation or driving off, a permanent gas will be produced, and this gas may either be collected or suffered to escape, as may be thought expedient. The crude oil obtained, as already described, is purified in the following manner: I put the oil into a cistern, and heat it (by a steam pipe or other means) to a temperature of about 150° Fahr. When thus treated, water and undissolved impurities contained in the oil will separate more readily from it than when cold, and the oil being left in a state of rest and kept warm for about a day, many of those impurities will fall to the bottom of the cistern, and the oil may then be run off into another vessel, leaving the residuum behind. For distilling the oil the inventor prefers to use an iron still with a worm-pipe connected to it, passing through a refrigeratory apparatus, which is kept at or about the temperature of 55° Fahr., as already mentioned. The still is heated by a fire underneath it, which is kept up until the whole of the oil has been distilled over, and it will then be found that the still contains some dry carbonaceous residuum, which should be taken out before the still is again used. The oil is to be run from the condensing apparatus as it distils over into a leaden vessel, where, to each 100 gallons there are gradually added 10 gallons of the oil of vitriol of commerce. After this mixture has been well stirred for about an hour, it is to remain at rest for

about twelve hours, so that the oil of vitriol and the impurities with which it has combined may settle at the bottom. The supernatant oil is then drawn off into an iron vessel, and to four gallons of a solution of caustic soda, of a specific gravity 1·300 (water being 1·000), added to each 100 gallons. The soda and oil are stirred together for about an hour, so as to neutralize any acid which may remain in the oil, and also take up any impurities capable of combining with it, after which the contents of the vessel are allowed to remain at rest for about six or eight hours, so that the solution of soda may subside, and then the supernatant oil is to be drawn off, and again distilled in the same manner as already described. Parafine oil obtained from the last mentioned distillation contains a fluid more volatile than parafine, a considerable portion of which may be separated from the oil and obtained in a separate state as follows: The oil is placed in an iron still connected with a worm-pipe passing through a refrigeratory apparatus, and half its bulk of water being added, the contents of the still are boiled for about twelve hours, adding water from time to time, so as to keep about the same proportions of oil and water in the still.

The volatile fluid will pass over along with steam, and be condensed in the worm-pipe by the refrigeratory apparatus. This fluid will be clear and transparent, and as it is lighter than water, it separates, on standing, from the water with which it will be mixed as it leaves the worm-pipe of the still. This fluid may be burnt for the purpose of illumination, or applied to any other useful purpose to which it may be applicable. The last-named process will separate the greater portion of the volatile fluid from the oil, but a larger quantity may be separated by prolonging the operation. The oil left in the still after the completion of the process is then to be carefully separated from all the remaining water (upon which it will float) and conveyed into a leaden vessel, where two gallons of oil of vitriol are to be added to each 100 gallons. This mixture is to be well stirred for six or eight hours, after which it is allowed to stand undisturbed for twenty-four hours, in order that the vitriol may settle to the bottom of the leaden vessel, carrying with it all impurities with which it has combined. The supernatant oil is now to be drawn off into another vessel, and to each 100 gallons there is added 28 lbs. of chalk, ground up with a little water into a thin paste. The oil and chalk are to be well agitated until the oil becomes entirely freed from any trace of sulphurous acid, which may easily be known by heating a little of it in a glass retort, and testing its vapors by moistened blue litmus paper. If the vapors change the color of the litmus paper to red, the oil must be treated with more chalk. This oil is to be kept warm—say at 100° Fahr.—in any convenient vessel for about a week, to allow impurities to settle, and it is then fit to be used for lubricating purposes, either

by itself or mixed with an animal or vegetable oil, or it may be burnt by itself in Argand lamps for the purpose of illumination. To extract parafine from the purified parafine oil obtained in the manner described, the oil is to be cooled to a low temperature—say to 30° or 40° Fahr.; and the lower the temperature, the larger will be the quantity of parafine separated from the oil. In this way parafine is made to crystallize, when it may be separated from the oil by filtration through woollen or other cloths, and then squeezing it in a powerful press, by which means it will be made sufficiently pure to be employed for lubricating and some other useful purposes. But the parafine may be further purified, if required, by treating it several times, at a temperature of about 160° Fahr., alternately with its own bulk of oil of vitriol and with a similar quantity of a solution of caustic soda (of the specific gravity already mentioned) until the parafine ceases to render the oil of vitriol black. It is then to be washed in a weak solution of soda, and lastly with boiling water, until the water ceases to change the color of red litmus paper. Another method adopted to obtain parafine from parafine oil is, to put the oil into a still, and distil over one-half or more of its contents. The portion then remaining will contain a much larger proportion of parafine than the parafine oil at first put into the still contained; this residue being then distilled over into a separate vessel, and allowed to cool. Parafine may be separated by filtration and squeezing in cloths, and also purified by treatment with oil of vitriol and soda, as before described. Parafine oil from which parafine has been separated, as above described, still contains parafine in solution, and is suitable for lubricating or lighting purposes.

ART. VI.—SOME REMARKS ON COAL MINING.—By J. MARLOR.

THE frequent and deplorable cases of explosions of fire damp in coal mines, and the great loss of life which has attended many of them, in numerous instances not one having been left alive to tell the dismal story how or what was the immediate cause of the catastrophe, are well calculated to call forth the strongest feelings of pity and compassion for the sufferers and their families from every class of society in the country; and the question naturally arises to the sensitive mind, can nothing be done to prevent these awful calamities? Can no means be used to make them at least less destructive when they do occur? It is pleasing to know, that much may be done to lessen or prevent these dreadful accidents; and this suggests the fact, that the principal thing to be attended to in all mining operations, is ventilation.

Ventilation in coal mines, is obtained by the atmospheric air

descending one shaft or pit, and ascending another shaft or pit. The pit in which the air descends, is called the down-cast pit; and that in which it ascends, is called the up-cast pit. There is, generally, a large fire at the bottom of the up-cast pit, which, by rarifying the surrounding air, considerably increases the volume of air ascending and descending the pits. But the air is not allowed to ascend and descend simply in this manner. It has to be conveyed to every part of the mine where the men work; and in many cases it has to travel a number of miles in the bottom before it finally escapes by the up-cast pit. There ought therefore to be such a volume of this air passing through all the various workings of the mine, as shall force out and dilute all the inflammable gas, which the mine produces, below the inflammable point; and if this be not done, the danger will be imminent, and an explosion is almost certain to take place.

There can be no mistake in this, that it is the want of a sufficient quantity of atmospheric air circulating in the mine which is the real cause of all explosions; and my object, in making the remarks which follow, is, to show that much, yea very much, may be done to prevent these explosions, or at least that they may be fewer and less destructive when they do occur. This object can, and I trust will, soon be accomplished.

In many of the explosions which have happened in different parts of the country, there have been many lives lost by the after-damp (as it is commonly called). Many of the men were neither bruised nor burned, but had died in consequence of the deficiency of vital air. The oxygen which existed in the atmospheric air of the other portions of the pit had become absorbed by the large flame of gas, as far as it had extended. Oxygen gas, it is well known, is the principal supporter of combustion, and also of animal life; and as soon therefore as the oxygen of the atmospheric air is consumed, the flame goes out, and a vacuum is formed in the place which it occupied, and in an instant there is a rush of the surrounding air to fill up the vacuum which has been thus created, and which as it passes along destroys every thing in its way that has life. The stoppings are blown down, the doors are broken to pieces, and thus the whole system of the ventilation is destroyed, and if some of the men should escape the flame, and the blast, and be neither bruised nor burned, yet if they have to pass through the after damp, to get out of the pit, it is probable they would be killed in a few minutes. The scene is dreadful to contemplate: every thing is destroyed, or deranged, as far as concerns the ventilation. The lights are blown out by the blast, and the poor sufferers, if they are alive, have not an earthly hope on which to rest—to them all is darkness and despair. If life could by any possibility be prolonged for even a short time, in such instances, there is scarcely a gleam of hope for the sufferers, as those who are ready and willing to render them every assist-

ance in their power, cannot do so in time to save them, the dilution of the noxious air having to be carried on as they proceed in their endeavors to render assistance; and it is generally found when they do arrive at the place where the poor sufferers are, that help is of no avail.

If a plan of brick stoppings were adopted, with two brick-length walls, set in a curved form, so that the curves in the centre would touch each other, and the space between be filled up with rubbish or bricks, it might perhaps resist the blast of an explosion, if it were not a very powerful one. This form of making stoppings is suggested to prevent the destruction of the ventilation in cases of explosions. If stoppings could be made to bear the shock of the blast, the ventilation would still go on, more or less; and it is probable, if this were the case, some of the men who might have been neither bruised nor burned, would escape the after-damp, which is surely an object to be desired. The common plan of stoppings is brick-breadth walls which would prevent the air from passing, but when there is an explosion, these are blown down. In these walls there are four times more bricks than in the old plan, and probably they are much stronger; but whether they would stand the shock of a strong explosion I cannot say; but if the bricks were made bevelled, to form the curve, that they would not require any other material between them, perhaps the walls would be much stronger. A coat of plaster will be required on the bricks, the same as on the old plan, to prevent the air passing through the crevices.

It is probable that in many of the larger explosions, which have occurred in different parts of the country, if the ventilation had not been deranged, the coal would have been set on fire by the flame; but the after-damp, which destroys life, prevents it from burning. But what is it to have the coal on fire, compared with the heart-rending scenes which have been witnessed but too recently at Ince Hall and elsewhere? Surely the lives of the men ought to be held as of the first importance, and before any other consideration whatever. If those who do not happen to be killed by the explosion, can be got out safely, who is there that would not rejoice to see or know that this could be accomplished? As to the coal being set on fire by the flame of the explosion, if Mr. Gurney's scheme were adopted, which a short time ago was announced as having put out a fire in the bottom of a pit where the coal was on fire, it could be put in practice almost immediately, and at a trifling expense. It is simple and, I should think, efficient, as all the oxygen is absorbed from the air which descends the pit, by passing through fires before it goes down. It is well known that combustion cannot take place without oxygen, and of course, where it is absent it must be extinguished. If what has been said respecting Mr. Gurney's scheme be correct, it is of great value for coal mines, as a few days would probably be sufficient to put out fires recently kindled.

There is another subject which is of the greatest importance in mining operations, namely, the manner of getting the coal. This is a prominent consideration in connection with the ventilation of the mine; and I think, that in the greater proportion of the explosions which have taken place in different parts of England, more blame may attach to the system of working the mines than to the ventilation. The system pursued in the North of England of working the mines is, in my opinion, far from being the best, both with regard to the ventilation and also with regard to the plan of getting the coal. Perhaps it is hardly possible to have a larger volume of air descending and ascending the pits, than is to be found in their collieries; but it is the plan of working the mines, and the method of conveying the air to the different workings, to which I chiefly object. Any coals obtained in the opening of a mine, but what may arise in the driving of the roads or levels, must be wrong, generally speaking, especially if there be inflammable gas to be dealt with, as being done not with that skill and foresight for the present and future working of the mine, nor with that care for the safety of the men and the property of the concern, which ought to characterize all mining operations. The boundary of the concern should be reached before there be any opening out to any great extent. If this be not done, hollows are formed where there ought to be solid coal, and thus repositories of inflammable gas are formed, ready to blow up the works by the carelessness or inadvertency of the miners or by the roof falling in and driving out the gas in a body, so that it will fire at the first open flame with which it comes in contact, and of course an explosion is the result. There should be no roads or levels driven but those which are really needed to connect the different workings, so as to give as much facility for taking away the coals as the case may require. The making of goaves or hollows, before opening out the works at the boundary of the concern, should also be avoided, and thus there will be no hollows except those at the extreme workings of the mine. The coals should be cleared out at once; without leaving pillars with a view of working them over again, as is done in the North of England. Let the volume of the air sweep up to the old hollows or extreme workings; let the men have lamps; and let the different workings or ranks come back in regular rotation, something like a body of mowers mowing a field of grass, and thus continue to work out the mine until the whole field of coal is exhausted.

In the North of England the mines are worked in a very different manner from what I have here recommended. Custom and prejudice may have much to do with this, and perhaps also the different circumstances connected with the mines. The tubs or corves, which are used to remove the coals, and any or all these may have some effect in leading to the adoption of the varied modes carried out in different districts of the same country, and

are therefore no doubt considered in such places to be the best by those who adopt them. In the North of England, I believe the mines generally lie at a very gentle inclination, compared with those in some parts of Lancashire. The dip of the mines in the former, in many places, is about one in 20 or 24; and where this is the case, they can drive out in almost any direction. The roof and floor of the mines are generally good and sound, which, with the slight inclination of the strata, are great advantages; and these advantages may therefore be the cause of their working them in any direction. But let the cause be what it may, such a mode of working is calculated to interfere with the proper organization which ought to be carried on in the working of coal mines, both with regard to the ventilation, and also the working out or getting all the coals, with the least loss in the operation. There cannot be too much stress laid upon this point: there should be a general principle laid down, by which the mine should be worked, including the system of ventilation. There may no doubt be cases arising in the progress of the work, which will require a different mode of proceeding; and where this is so, it is what I should call improvement to do it. Indeed, there are in some coalfields, such a combination of varied difficulties, affecting the regular mode of working the mine, that a change of proceeding must be adopted to suit the varying circumstances. The occurrence of faults frequently interfere with the regular system of working, especially where it happens that there is a good roof on one side of the pit and a bad one on the other. Where this occurs, the same breadth or rank of coal cannot be obtained between the levels where the roof is soft as where it is hard; and in such a difficulty, the plan of working requires to be varied accordingly.

The inclination of the mine has much to do in producing different forms of working, and also in the materials that may be required, such as tubs or wagons to suit the varied cases. I have seen one pit, where the inclination on one side of the shaft was one in five, or five and a half, and on the other side it was one in two, or two and a half. In such circumstances, the ranks, or breadth of coal between the levels, will vary in their thickness progressively. On that side where the inclination is less, the ranks or breadth of coal between the levels will increase in breadth; and on the other, where the mine gets steeper, they will get thinner in proportion as the mine becomes steeper. In such cases as these, the levels will form a sort of regular curve, which will increase the breadth of the ranks between the levels on the north side of the pit, as the inclination gets more gentle; and on the other side, the breadth will become narrower as the inclination gets more steep. I have seen a case of this kind at one pit, in which the ranks were set out at the shaft, 36 yards in breadth, and in driving about 200 yards on the north side, they had increased to 50 or 55 yards; this additional breadth was occasioned by the mine inclining less

at this distance than at the shaft. The same mine, on the other side of the shaft, at the same distance, had increased in its inclination so much, that the thickness of the ranks was narrowed from 36 to about 20 or 21 yards; and although there was this variation in the thickness of the ranks of coal, yet the levels were good. Where there is a variation in the inclination of the mines, these levels cannot be straight; they will be curved or form a sort of basin, and it cannot be otherwise, where such a variation exists.

[To be continued.]

Art. VII.—THE IRON MANUFACTURE OF GREAT BRITAIN—THEORETICALLY AND PRACTICALLY CONSIDERED.*—By Wm. Truran, C. E.

RAW MATERIALS USED IN THE MANUFACTURE.

In the manufacture of Pig Iron, the raw materials consist of Iron-ores; Fuel, either coal, coke, or charcoal; and limestone, or some other substance as a flux. Before enter ng on the smelting operation, we purpose giving a brief description of the qualities and general composition of the principal ores, fuels, and fluxes used in the manufacture in this country, and will commence with the

IRON ORES.

The ores from which crude iron is smelted in Great Britain may be divided into four great classes. The argillaceous ores of the coal formations, having clay, but sometimes silica, as the chief alloy with the metal; the carbonaceous ores of the coal formation, distinguished for the large per-centage of carbon in combination; the calcareous, principally from the limestone of the coal measures, having lime as their chief earthy admixture, and the siliceous ores, having silica as the predominating earth. These last

* The Iron Manufacture of Great Britain, theoretically and practically considered, including descriptive details of the ores, fuels, and fluxes employed; the preliminary operation of calcination; the blast, refining, puddling, and balling furnaces, engines and machinery; and the various processes in union; statements of the qualities of material; period of time, and amount of power consumed in the successive stages; cost of raising minerals; and manufacturing crude and finished iron; and analytical researches into the causes affecting the economy of fuel in blast furnaces. By William Truran, C. E. Illustrated by twenty-three plates of furnaces and machinery in operation.

Note.—This entire work with the plates will be re-published entire in the pages of this Magazine, with American notes.—Ed.

are subdivided into the red and the brown hematites; the ores of the oolitic formation; the white carbonates, and the magnetic oxides. Silica is frequently the predominating earth in the carbonates of the coal measures, but from the large per-centage of carbonic acid in combination, their classification with the argillaceous ores distinguishes them from the siliceous ores of the oolitic and other formations, which do not contain any important quantity of this acid.

ARGILLACEOUS ORES.

The Argillaceous and Carbonaceous ores are obtained from the coal measures in which they are found, in seams from ¼ inch to 8 feet thick, and in nodules varying from 1 inch to 2 feet in diameter. Lying parallel with, and not unfrequently in close proximity to the coal seams, these ores are mined in a similar way to that followed in the extraction of the coal in the same locality. A large quantity is annually raised by open workings termed "Patching," in Wales, but the principal supply is derived from pits sunk in the coal measures, to depths varying from a few yards to 150 fathoms.

All the great coal formations hitherto discovered, contain argillaceous and carbonaceous ores in less or greater abundance. The Staffordshire, South Wales, North Wales, Derbyshire, Shropshire, and Scotch coal fields contain valuable seams of the argillaceous ore. In the Durham, Lancashire, Somersetshire, and other minor coal fields, the argillaceous ores exist in sparing quantities, and producing, when smelted, crude iron of an inferior quality.

The South Wales coal field stands pre-eminent for the number and richness of its seams of argillaceous iron ores. The aggregate thickness of the seams is nearly 22 feet; and the average per-centage of metal in the ores exceeds 32 per cent. We annex the analyses of a number of seams wrought by the Dowlais Iron Company, and which form the chief supply of ores to their blast furnaces. The Pennydarran, Plymouth, and Rhymney furnaces are worked with the produce of the same seams; and the variations in the composition at other workings eastward and westward of the Dowlais Company's is inconsiderable. Hence, taken from the centre of the manufacture in the South Wales districts these analyses may be considered as fairly representing the mean composition of the Welsh argillaceous ores.

ANALYSIS OF ARGILLACEOUS ORES OF THE SOUTH WALES COAL FIELD.

	1	2	3	4	5	6	7
Carbonate of Iron...	74.5	86.0	77.1	62.0	42.7	59.5	68.2
Silica...............	14.5	8.3	15.9	27.5	43.0	36.9	21.6
Alumina............	8.3	.2	3.8	7.8	7.5	1.9	5.4
Carbonaceous matter.		4.2	1.8	2.1	2.8		3.8
Lime...............	.8		.4		.1		
Manganese..........	1.3				2.5	.4	
Phosphoric acid.....	trace				trace		
Moisture and loss....	.6	1.3	1.0	.6	1.4	1.3	1.
Yield of Metallic Iron	35.9	41.46	37.2	29.9	20.6	28.7	32.9

The richness of the respective seams of ore in this field, is influenced by their proximity to other seams. Where two or more seams of ore exist with only a thin parting between, the mean per-centage will be higher than that of seams having a great thickness of ground interposed. The general character of the alloyed earth is influenced in a similar manner by the composition of the matrix, and to a minor degree by that of the adjacent seams of rock, shale, or clod. The metal in seams of ore, having shale as their matrix, is alloyed with the earths composing the shale, in nearly the same proportion to each other as they exist in the shale. Seams of argillaceous ore, having either a roof or bed of siliceous rock, invariably contain a large per-centage of silica. The lowest seams of ore, as they approach the mountain limestone, are found to contain a notable per-centage of lime—a substance almost entirely wanting in the richer seams of the upper series of the field.

On analyzing 68 seams of ore used in the Dowlais furnaces, comprising the whole of the argillaceous ores of the north outcrop, we found that 47, or more than two thirds, yielded 30 per cent. and upwards. Two seams exceeded 38, and four exceeded 37; while there was five of 36, nine of 35, eight of 34, three of 33, four of 32, three of 31, and nine of 30 per cent. Three seams only were under 20 per cent.

The South Wales basin contains, in addition to the workable seams we have enumerated, several seams of ore, yielding a low per-centage of inferior iron. By the workmen they are known by the local appellation of "Jacks," or coarse ironstone. They are never used when the quality of the resulting metal is desired to be good. For the inferior irons, however, they are sparingly used with other ores. The general composition of these ores is represented by the accompanying analyses of a seam wrought by the Dowlais Company.

Carbonate of Iron..............	27.8
" " Lime.............	48.8
Silica..........................	10.9
Alumina......................	10.5
Carbonaceous matter...........	1.
Moisture and loss..............	1.

Metallic Iron 12.7 per cent.

The Staffordshire coal field contains numerous seams of argillaceous ores, from which the blast furnaces of the district derive their principal supply. In point of richness they are slightly inferior to the average of the Welsh ores, but in the quality of the resulting iron they are equal. The analyses of one of the richest specimens of this field, obtained from near Dudley, gave

Carbonate of Iron	78.3
" " Lime	5.2
" " Magnesia	4.7
" " Manganese	1.7
Alumina	1.8
Silica	5.6
Phosphoric acid	trace
Carbonaceous matter and loss	2.7

Metallic Iron 37.7 per cent.

The analyses of a compound sample, intended to represent the average yield of the seams, gave

Carbonate of Iron	62.8
" " Lime	4.6
" " Magnesia	3.5
" " Manganese	2.1
Alumina	5.6
Silica	16.8
Carbonaceous matter	2.3
Moisture and loss	2.3

Metallic Iron 29.3 per cent.

The North Wales coal field contains seams of argillaceous ore, but the average yield of metallic iron does not exceed 25 per cent. on the raw ore. The Derbyshire field supplies a considerable quantity of these ores, but the produce is generally inferior to the South Wales. According to M. Bunsen, the composition of the ores smelted in the Alfreton furnaces, after calcination, was as follows:

Peroxide of Iron	60.242
Silica	25.775
Alumina	6.583
Lime	3.510
Magnesia	3.188
Potash	.743
Manganese	traces

Metallic Iron 41.7 per cent.

The Yorkshire coal field contains numerous valuable seams of argillaceous ores, and, when this district is supplied with greater facilities for the conveyance of the manufactured iron to market, it is probable that the make of iron will be largely increased. Looking at the small per-centage of clay, and the comparative freedom of these ores from sulphur and phosphoric acid, this district will eventually produce large quantities of very superior iron.

We annex the composition of five of the seams under the manor of Healaugh, Swaledale, according to analyses made by Dr. Odling.

ANALYSES OF ARGILLACEOUS ORES OF THE YORKSHIRE COAL FIELD.

	1	2	3	4	5	mean.
Carbonate of Iron......	80.5	70.8	75.8	79.0	65.59	74.3
" " Lime.....	8.48	11.72	4.72	8.36	21.28	9.9
Silica and Clay........	8.72	10.72	10.6	10.8	6.16	9.8
Carbonate of Magnesia..	.25	.63			1.23	.43
" " Manganese	traces	traces	traces			
Carbonaceous matter, loss Moisture and Sulphur...	7.05	6.18	8.88	2.38	5.74	6.07
Yield of Metallic Iron...	38.8	34.17	36.6	38.1	31.6	35.8

The Scotch mineral field contains large quantities of argillaceous ore. Before the discovery of the more fusible carbonaceous ore, these formed the chief supply of the blast furnaces in this district, but of late years they have been comparatively neglected. The great value of these ores is, however, very manifest from the following analyses by Dr. Colquhoun.

ANALYSIS OF ARGILLACEOUS ORES FROM THE SCOTCH COAL FIELD.

	1	2	3	4	5	6	7	8
Protoxide of Iron . .	35.22	45.84	42.15	38.80	36.47	47.38	43.73	53.03
Peroxide	1.16		.80	.33	.40	.38	.47	.23
Carbonic Acid . . .	32.53	33.63	31.86	30.76	26.85	33.10	32.24	35.17
Protoxide of Manganese		.20		.07	.17	.18		
Lime	8.62	1.90	4.93	5.30	1.97	2.00	2.10	3.33
Magnesia	5.19	5.90	4.80	6.70	2.70	2.20	2.77	1.77
Silica	9.56	7.83	9.73	10.87	19.20	6.63	9.70	1.40
Alumina	5.34	2.53	3.77	6.20	8.03	4.30	5.13	.63
Carbonaceous matter .	3.13	1.36	2.33	1.87	2.10	1.70	1.50	3.03
Sulphur	.62			.16		.22	.02	
Yield of Metallic Iron .	28.4	35.3	33.	30.	28.4	36.7	34.	40.9

CARBONACEOUS ORES.

The most valuable seams of Carbonaceous ores hitherto discovered belong to the Scotch coal field. The thickness of the seams in the field varies from a few inches to several feet. It is observed, however, that the thickest seams are not so rich in metal as the thinner, and as a rule the quality is also inferior.* The

* By some writers, these ores are termed "carboniferous," by others, "blackband," this last correctly designates particular seams in which the ore alternates with thin bands of coaly matter: but the majority of these ores, though abounding largely in carbonaceous matter, do not exhibit this stratification. We have adopted the term carbonaceous, as being more comprehensive—embracing as it does all ores containing a considerable per-centage of carbon. We may also remark that from inattention to the sectional appearance of the various ores, writers frequently use "clay band" for argillaceous ore, thereby leading the uninformed reader to the erroneous conclusion that the clay existed in these ores in the form of thin bands, similar to the coaly matter, combined with particular seams of carbonaceous ore, instead of being equally disseminated through the entire mass.

In Scotland some of the beds of carbonaceous ores are known as "Mushet's

general composition of the richest seams of the Scotch carbonaceous ores is represented in the following analysis, principally by Dr. Colquhoun.

	No. 1.	2.	3.
Protoxide of Iron	53.03	40.77	53.82
Peroxide "	.23		
Sulphuret "		2.72	.23
Carbonic acid...	35.17	26.41	34.39
Lime..........	3.38	.90	1.51
Magnesia.......	1.77	.72	.28
Silica..........	1.40		
Alumina........	.63	10.10	2.00
Carbon, matter..	3.03	17.38	7.70
Moisture.......	1.41	1.	
Yield of Metallic Iron	41.2	34.6	41.6

From numerous experiments we consider the quantities of carbonaceous matter in these analysis as below that existing in the mass of the Scotch carbonaceous ores. The variation in the composition of these ores is further exemplified in the following analysis:

	No. 1.	2
Carbonate of Iron........	85.44	29.03
" " Lime.......	5.94	1.52
" " Magnesia....	3.71	3.59
Silica...................	1.40	24.76
Alumina................	.63	20.10
Peroxide of Iron........	.23	
Carbonaceous matter.....	3.03	21.71
Yield of Metallic Iron........	41. 3	14.0

Seams of carbonaceous ore exist in the other coal fields, but generally the produce of metal is not equal to that obtained in Scotland. In the Durham district, carbonaceous ores are wrought to a limited extent. The North Wales field contains seams of this ore, but the yield is inferior. In the North Staffordshire district, this ore is worked to a considerable extent. A specimen analyzed by Herapath gave

Protoxide of Iron.............	42.25
Bisulphuret of Iron...........	3.53
Protoxide of Manganese........	7.48
Silica.......................	2.20
Alumina.....................	.50
Lime........................	4.09
Magnesia....................	2.60
Bituminous matter, Carbonic acid, Water and loss	37.35

Metallic Iron 34.2 per cent.

To be continued.

blackband," after the late Mr. Mushet, to whom the merit of discovering this ore is due. But Mr. Mushet appears to have been as little acquainted with the peculiar qualities of this ore as other iron masters, and it was not till about 1830, that it began to be extensively used in smelting.

COMMERCIAL ASPECT OF THE MINING INTEREST.

New York, October 26th, 1855.

Mining stocks still remain in a state of torpor. There appears no market for any but those of a few coal-mining and transportation companies. The money market during the month that has elapsed since our last notice, has been much troubled. The city banks have contracted nearly five millions dollars in their loan and discount line, which has caused the sale of a large amount of stocks hypothecated, and at a serious depression in price. Money, however, has become easier during the last week, but confidence has become weakened owing to some financial difficulties apprehended in the Bank of France, and to the large loss of specie by that institution and the Bank of England, notwithstanding the heavy supplies from the mines of California and Australia. Coin continues to flow to the seat of war, and to be in no hurry to return. Much also is hoarded, and the concentration of supply of gold in one corner of Europe deranges the usual circulation. At no distant period, however, the coin must return from the districts where it has been sent to the centres of circulation, where money is rising daily in value. The Bank of England now charges 5½ per cent. for its discounts, the Bank of France 5 per cent. In this market the rate for the loan and discount of money is now nine per cent. The banks, indeed, only charge seven, but only to customers who keep good balances, the cost of keeping which is considered to raise the rate of discounts to 10 or 12 per cent. The discount broker charges from 8 to 12 per cent., according to date, and credit of the acceptors, but 8 per cent. is only for very favorite names. The shipment of specie to Europe is considered to be nearly over, as the rates of exchange in Europe have fallen, and bar gold has depreciated to ⅜ of one per cent. The export of produce is active both here and at the Southern ports. Our grain and flour, our pork and beef, our tobacco and rice, and especially our cotton, the receipts of which are unusually large, are all in course of active shipment, and will more than balance the imports of foreign merchandise without the aid of gold. If we send much more gold, it must necessarily return. But this is for the future. The extensive products of our harvest place our present prosperity without bounds, on a basis which must give rise ultimately to increased consumption of the articles of luxury as of necessity, and to additional speculation in works of supposed reproduction. Among the latter, we include mining adventures, as the result of our present base of wealth, when realized, will be one revival of mining speculation. Coal and copper, gold and lead, and zinc companies will revive in very butterfly activity from their present larvæ state.

The stocks of the Reading, the Cumberland Coal and the Pennsylvania Coal have been alone active, but at a considerable decline in price. The Cumberland Coal Company has announced an arrangement by which its six per cent. bonds due in January next, have been bought in at 95 to 97 per cent., and new ones issued at seven per cent. on the old mortgage, except that the company is rendered at liberty to dispose of a portion of its coal lands. We understand that negotiations are in progress, and will doubtless be consummated

shortly for the sale of a large portion of its coal property, or that a dividend will be placed within easy reach of time. Cumberland Coal Stocks have been less depreciated than any other—to day it sold at 26, Reading at 90¼, and Pennsylvania Coal at 99.

We have no transactions in other mining stocks to report. McCullock Copper Mining Stocks and Aberdeenfield Stocks seem to be cases of suspended animation. Mr. Butterworth, Superintendent of the Assay Office in this city has taken a large interest in Aberdeenfield Company, and has conducted some experiments on its ore, with what result we have not yet learnt. Some time ago there was a little activity in the stocks owing to purchases made by Mr. Butterworth's friends, and as high as 88 cents per share was obtained. It can now be bought for twelve cents, which looks unfavorable for Mr. Butterworth's operations.

The working of mines is likely to be much assisted by Heman Gardiner's Patent Quartz Crushing Mill and Amalgamator, to which we have already alluded, and which we have described in previous numbers.

The Lake Superior region continues to show favorable results on its older established companies, whose yield will be greater this season than in any other; but the new companies show no progress, being hindered by the want of capital and lack of speculation.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA GOLD FIELDS.

The yield of gold in California is more abundant and reliable this year than any previous one. Instead of presenting details of mining, at this time, we prefer to notice some parts of the Report of Prof. Trask, on the Geology of California.

MINERAL PRODUCTS OF LOS ANGELES, &c.

A brief review of the agricultural capacities of the soils of this part of the State has been given, and I would say in this connection, that in these particulars lie the strength and principal value of the lands throughout the district generally; the mineral resources of this range of country so far as examined, being comparatively of little value.

The transverse chain of the Pacific coast (San Bernardino chain) appear thus far to act as a barrier, and to have cut off almost completely the rich mineral deposits found in the mountains of the more northern sections. There are a few localities, it is true, where auriferous deposits of limited extent are met with, but no general features which would in the slightest degree indicate that they extend over any considerable areas. So far as I have been able to learn, both from personal inspection and information derived from others of localities which I have not visited, I entertain the opinion that no extensive deposits of gold will be found south of these mountains, and few, probably, that would warrant mining explanation. There are some evidences existing that silver may be met with in the southeastern spurs of this chain, but to what extent is yet undetermined. The limestone rocks of the Armagosa, and the granite and quartz of this section, contain both gold and silver, but they are situated to the north of this chain, yet the *gypsum beds* found near their southern base and on the southern part of the Colerado Desert are found to

contain gold in small quantities, not sufficient, however, to pay for working. The predominating metaliferous rocks of these mountains, so far as known, consist mostly of copper containing lead and silver; the heavier quantities of these ores lying upon the Rio Santa Clara, in the County of Santa Barbara. Bismuth and iron are also met with in these mountains, the former to a limited extent, the latter more generally disseminated and forming small veins among the primitive rocks. Both of the latter minerals are found in the immediate vicinity of the Mission of San Buenaventura, and the former (Bismuth) in the mountains near the coast in the vicinity of the rancho Guadaloupe. The principal mineral products of these counties, of any commercial importance, are the beds of sulphur; they commence in the County of San Luis Obispo, and through alternate distances of two to six miles, extend to the County of Santa Barbara, and northern part of Los Angelos. The larger proportion of these beds lie near the coast, and form the investing surface material of those volcanic vents found upon this part of the coast, and which have been alluded to in the preceding pages of this report. Thsse sulphur deposits will, at a future day, be worked with profit when the demand for this article shall exceed that of the present time, and still I think the present demand is sufficient to warrant the investment of capital in this quarter, where the mineral is found in sufficient quantities to render the working of its mines a lucrative operation.

The appearance of magnetic sands among the drift found in the beds of the arroyas led me to the supposition that gold might exist in their connection, which, upon examination, was found to be the case, although in very trifling quantities. The same thing was found to exist upon the beach three miles southeast of Santa Barbara. This metal was probably derived from the heavy gravel drift which is found in the immediate vicinity.

Bitumen is another of the more abundant mineral products of this portion of the State, and is found in very large quantities. This article is available and well adapted to the manufacture of gas for the purposes of illumination, and will probably be used to considerable extent in this country, the only practical objection to such a use of it being the fact that no valuable residuum is left in the retort after the extrication of the gaseous constituents; as this mineral yields a much greater volume (being nearly double,) of illuminating gas, than any other in use, it is very questionable whether it would not be equally profitable from this circumstance. In the use of coal, we have the coke remaining which may be applied as an article of fuel, but the value of the latter in the market would probably be counterbalanced, by the increased volume of illuminating matter contained in the simple bitumen. The expense of transportation of coal from distant regions must very materially enhance the price of the commodities resulting from it, but in the use of the asphaltum upon our coast, this heavy item would, as a necessary consequence become materially diminished. The only real objection to the introduction of the latter article for the above purposes is that there may not be sufficient quantities of the mineral obtainable for so extensive uses as would be required; this is a valid objection, and should be well considered before entering upon a speculation of that kind; from what is already known of these beds, they certainly have the appearance of being adequate to the supply of any ordinary demand for those purposes, as they are frequently to be met with covering many acres of ground. This fact however in regard to quantity can only be determined positively by clearing one or two of the larger springs, and thus ascertaining the actual amount of the mineral discharged per day or per week, and should it be found anything near adequate to the demand for gas manufacture, its collection and transportation at fair rates of prices, will form a much greater source of revenue to this district than the entire cattle trade of these counties at the present time. A little attention to this subject will convince us that a heavy and lucrative business may be conducted in this department of trade, if the necessary measures are adopted to bring this element into practical notice, for as stated in the preceding pages these springs extend from the county of Santa Clara to San Diego, and most of them near the coast.

To illustrate more fully the advantages to be derived, and the extent of business that now lies untouched in this particular, it will only be necessary to allude to the quantity of coal required for the purposes of illumination at present in this State. The requirements for the city of San Francisco is about 5000 tons per annum, at an average price of 22 dollars per ton, equal to 110,000 dollars, the demand for Sacramento is equal to about 2000 tons, which at the same price equals 44,000 dollars, the total amounting to 154,000 dollars. Allowing the coal to produce (which the best quality will) about 1100 pounds of coke from the ton of coals, the value of the coke as sold here, at about 62 cents (high price) per bushel, will yield a return upon the original cost of a little more than twelve dollars per ton, or a sum total of nearly $87,000. This estimate is based on the product of the Scotch coal, the specific gravity of which is but 1.27. The Asphaltum of this State has a specific gravity of about 1.62, the difference in the excess arising probably from the earthy matters contained therein.

There cannot be less than 4000 tons Asphaltum lying upon the surface of the ground in the counties of Los Angeles and Santa Barbara alone, within a few miles of the coast at the present moment. Its value delivered in San Francisco would not be less than sixteen dollars per ton, equal in value to 64,000 dollars, and this amount alone would offer sufficient inducement to embark in the enterprise independent of any other consideration. The amount lying upon the surface in other adjacent counties is probably equal to the amount in those specified, so that 8000 tons would be a safe estimate to place upon the quantity already available.

The analysis of this mineral exhibits the following available constituents for the manufacture of gas; in one hundred parts there is found a limpid oil equal to thirty per cent, and the same amount of charcoal with a large per cent. of ammonia, the balance consisting of earthy matters and water. Here then we have 60 per cent of the gross weight applicable to immediate use, the charcoal holding the same relations to the bitumen, that exist in the coke to the coal. That the supply of this article is abundant, there can be but little question, and fully equal to 5000 tons per annum (the requirements of the State will not fall short of this figure for years to come), equal in value, at 16 dollars per ton, to 80,000 dollars, and should it possess no more than an equal amount of illuminating matter, it will be seen that it will be far more economical than the present use of coal. The only, or rather the principal question asked by those interested in gas manufacture, is this, is there a sufficient quantity to meet the demand for 8000 tons per annum, in other words, if there is a sufficient quantity, is there every evidence of quality also to make it a reliable resource?

The proper opening of these springs would undoubtedly furnish an ample quantity of the mineral, and if the business should be judiciously managed, it would prove lucrative and permanent. It is to be hoped that this brief allusion to this subject, may elicit attention from those who are intimately acquainted with the localities in which it is found, to its proposed value, as well as to the quantities which may be supplied.

Limestone is found in considerable quantities among the higher hills of this part of the State. Without any exception I believe it is primitive, and the greater part of it possesses a high crystalline structure. It is well calculated for the manufacture of lime, and proportionately less fit for any other application to building purposes. The granites which form the principal basis of these mountains, is usually of a hornblendic character, often running into true Sienite. It is ill adapted to purposes of building, both from its constituents, and its general consistency, and it is generally in situations remote from navigable waters, a fact which forbids at present its transportation for such purposes, even were it found to be of a better quality.

I have thus given a general outline of the geological characteristics of this part of the country, and the more prominent economic adaptations of its resources, which may be derived from them, by the enterprise of our citizens, when the industry of the people, as well as their capital shall be invested in their develop-

ment. It would be incompatible with the limits of an abstract report like this, to enter into the minutiæ of the more scientific details which might naturally be drawn from so abundant a field of investigation. I have thought it advisable in this as in former reports therefore to omit them, with a view to furnishing such as may be deemed useful, together with accompanying illustrations, in a final report of a more complete form in detail, upon the geology of California.

In the appendix of this report will be found a catalogue of the fossils, minerals and specimens representing this portion of the country, less full however in detail than that which will hereafter be presented, when they can be systematically arranged so as to convey a clear idea of their relative ages and positions.

With these remarks on this part of our subject we will now leave it for the purpose of turning our attention to the more northerly and equally interesting portion of the State.

MINERAL DISTRICT OF THE UPPER SACRAMENTO VALLEY.

We come now to the consideration of the mineral resources of the Upper Sacramento Valley. The upper portions of this valley lie for the most part on the east banks of the Sacramento River, with the exception of a small section above the Junction of Clear Creek, on the west side of the main stream. The southern boundary of what may be considered properly as the Upper Sacramento Valley (and which is mineral land for nearly its entire extent) I have proposed to comprise within the range of mountains, crossing the Pitt River, and forming a part of its southwestern banks, on the north, and the junction of Cow Creek on the south. This district will have a line of distance from north to south of about thirty-five miles, and a breadth of fourteen miles lying immediately north of the emigrant road leading from Noble's Pass, and entering the Sacramento Valley.

In passing across this section it was found that a large portion of the area included was a placer district, similar in most respects to the equivalent ranges on Butte Creek, and extending southerly through Long's Bar on the Lower Feather River, which is also observable in the vicinity of Camp Far West, on Bear River, and thence on to Rhode's Diggings, in the County of Sacramento.

Within this area there is at the present time a large mining population, and three considerable mining towns have been built up by the enterprise of that portion of our people who arrive annually by emigration across the territories and enter the northern parts of California through Noble's Pass, also coming through the American Valley. In the middle portion of this district there are situated some of the most extensive auriferous quartz leads, of any to be found in any part of the State, and from which the gold found distributed through the soil is derived. This entire district may be said to constitute a single large placer embracing an area fully equal to two hundred square miles, and probably the largest uninterrupted placer to be found in this country. The situation of this plain, enclosed as it is by high mountains on three sides, renders the climate mild and agreeable, with the exception of a short time during the dry season, when, like all valleys in this country, the temperature becomes somewhat elevated.

This placer range extends in a northerly direction beyond the Pitt River, on which stream the mining town of Pittsburgh is situated; it is said also to extend up McLoud's Fork, the principal northern tributary of Pitt River; of this, however, I am unable to speak from personal knowledge. I think there is no question but such is the fact, for my informants were men on whom reliance could be placed in matters of this character. In this district, as in many others in the State similarly situated, scarcity of water is the most serious impediment in the way of the miner in seeking for the profits of his occupation, as well as to the general growth and progress of the country. And wherever an ample supply of this agent is furnished for mining purposes, the

Upper Sacramento will give abundant employment to a large and busy population. I think there is no hazard in expressing the opinion, that this placer alone exceeds in area the aggregate of all the other known placers of Shasta County, in which it is situated, and is capable of giving employment for many years to four or five thousand men.

I consider the mining sections of this county equal in value to those of many parts of El Dorado, Placer and Nevada as they existed in the years of 1851 –2–3. They are much in the condition in which the flats and ravines in those counties were during those years, and which, since the introduction of water by canals, have yielded vast sums of gold, and such high remuneration for labor.

These mines are as yet almost untouched, and they require only that stimulus which has been applied in other counties to the south, to bring them into immediate use and occupancy. The rapid ascent of the Sacramento River after it enters the cañon immediately above the Upper Ferry is such that any amount of water would be easily obtained by diverting a portion of the stream, and carrying it by canals or ditches to the west of the river to be distributed among the high flats to the west from the town of Shasta, which flats abound in auriferous deposits similar to those of Middletown, Briggsville and other localities. A distance of six or seven miles from the mouth of the cañon would give sufficient altitude to carry the waters nearly as high as the summit of the hill on which is situated what is known as the Upper Springs, and within the town of Shasta.

A distance of three or four miles above the first settlement on the plain east of the river, the waters of the Sacramento may be diverted to any extent that might be requisite, and in quantities sufficient, if required, to nearly inundate the upper plain on that side of the stream, and a natural channel may be found of sufficient elevation a portion of the way, to convey the water over the undulating hills on the southern and middle portions of the prairie beyond.

The inducements for the investment of capital in mining operations which offer themselves in this immediate vicinity are unsurpassed in any county of the State south of this point, and it is a remarkable feature in the history of this district that they have not attracted that attention which their intrinsic merits suggest.

AUSTRALIAN GOLD YIELD.

From Australia, we have the news to June 25, via England. A monster nugget, weighing 1000 ozs., and valued at 4800*l.*, was found at the Maryborough diggings. The yield of gold was steady, and great hopes are entertained of making the exports of gold this year a hundred tons. At Melbourne, the gold market was not active, the buying price of the metal remaining at 3*l.* 17s. per oz.; and at Geelong, gold was 3*l.* 18s. per ounce. Several new diggings have been opened to the eastward of Melbourne, one of which (the Alma) is very productive, and another (the New Bendigo) is expected to turn out extremely rich. No part of Ballarat can be worked, owing to the accumulation of water, to remove which machinery is in course of erection. The general price of gold was 3*l.* 17s. 6d. per oz.

NORTH CAROLINA GOLD MINES.

RUTHERFORDTON, N. C., Oct. 17, 1855.

W. J. TENNEY ESQ., NEW YORK:

Do you imagine that I have forgotten you? Or do you think that I have at last burrowed so deep in some mining level, that no word from me can ever reach the busy bustling world of New York? Far from either of such suppositions is the case. But I have been hard at work for the past five months,

endeavoring by actual labor, and personal supervision, to solve some of the mysteries attendant upon Gold Mining. It requires close inspection, an unremitting watchfulness and strict scrutiny of even the most trivial circumstances attendant upon the manipulation of the ores, to know what plan of working to adopt, or what course to avoid. Determined to learn all that could be learned, I have passed hours, nay, days underground, studying the varying phases of the veins and ores, making sketches and notes of each new or interesting phenomenon; have handled the pick and spade, and delved out the ore; carried it up to the light of day, and pursued its constituents through all the intricacies of analysis; then have worked in all the different departments of milling the ores, and have learned much, but still only enough to show that it is but little that I do really understand. I passed over ten days, simply in "feeding" the "Rocker," that I might study out the why and wherefore of its use, and as simple as this rudely constructed apparatus appears, I find there is much that is not well understood by those who use it.

The "Arastre" or "Drag Mill" has claimed my attention, and the "Stirring Bowls," "Silliman's Bowls," and "Riffles" have also come in for their share of notice.

As I said before, I have taken notes of all that appeared of interest, and will in the course of a short time, when I shall have completed some further observations, send to the "Mining Magazine" my views upon gold ores and their mining.

The gold field is one of the most important branches of mining in the United States, and it is destined, I hope ere long, so to be known and appreciated by the friends of the mining interest. It is now looked upon as one of the most precarious class of mining; and this is a consequence of the course that has been adopted in working gold veins. It is a class of mining that requires more close attention than any other; the constantly changing character of the ores in the same vein; changing totally in value in the space of a few feet, although the same in all external appearances, baffles the experience that has been gained in lead, copper, or iron, mines. In such mines the ores are so distinctly marked in their characteristics, that they cannot be misunderstood; while in a gold vein the very gaugue-stone that is barren at one point, carries all the gold in the next few feet. Without the most rigid scrutiny, therefore, a pile of worthless ore might be accumulated, while the truly valuable portion would be thrown among the "deads." Then when the richest ore is in possession of the miner, its treasure will be lost in the manipulation, unless the utmost caution is observed. It does not follow that if one ton of ore can be washed in a given time, and yield a fixed amount of gold, that two or three tons washed in the same time will give two or three times the quantity of gold. The reverse would probably be the case; two tons would not give as much as the one, and three tons would give still less than either. The only safe method of washing gold ores, is to *wash them slowly.* If the quantity of ore is to be increased, the washing aparatus must be increased also. Happily the washing apparatus does not require much outlay of money to construct it, so that it can be extended to an adequate range for the increased quantity of ore at but a small expense. When I take up this

subject, I will give the dimensions or specifications of the various amalgamating apparatus generally in use, and endeavor to make my papers of actual use to the practical miner in this branch of industry. As it will probably be some six or eight weeks before I shall commence writing them, and as I desire to make them as useful to the miner as possible, I should be pleased to correspond with any one engaged in this branch of mining, who either has any thing now to communicate, or to whom I may perhaps be able to afford some slight information. To any who will address me upon the subject, I will cheerfully impart whatever facts I may be able to give. The knowledge gained in this branch of mining should be considered as free to all interested in it.

Yours truly,

STEPHEN P. LEEDS.

SOUTH AMERICAN GOLD REGION.

Next in importance to the Russian dependencies in Asia and Europe, the mines of Brazil yield a large quantity of gold, and have been most important since the discovery of America.

Gold is found in this country on both sides and for a very considerable distance at the foot of the immense chain of mountains running parallel with the coast, from the fifth to the thirtieth degree of south latitude. It is found more or less in almost all the rivers which form the upper branches of the Francesco, Tocantins, Araguay and Guapore, but chiefly in the affluents of the Francesco.

The face of the country is uneven and rather mountainous. The rock, when exposed, appears to be primitive granite, inclining to gneiss, with a portion of hornblende and frequently mica. The soil is red and remarkably ferruginous, in many places apparently of great depth. The gold lies, for the most part, in a stratum of rounded pebbles and gravel called *cascalhao* immediately incumbent on the solid rock. In the valleys, where there is water, occur frequent excavations made by the gold-washers to a considerable extent, some of them 50 to 100 feet wide, and 18 or 20 feet deep. On many of the hills, where water can be collected for washing, particles of gold are found in the soil little deeper than the roots of the grass.

It is particularly near Villa Rica, in the environs of the village of Cocaes, that the most numerous washings are established, and here the *pepitas* or lumps and scales of gold occur, mingled with the sand of the rivers of the alluvial deposits on their banks. In the province of Minas Geraes the gold also occurs in veins as well as in the form of grains disseminated through the alluvial loams, but it is only in comparatively recent times that attempts have been made to work the mines in the mountains.

Before the beginning of the last century the quantity of gold obtained was inconsiderable, but it increased rapidly. The greatest quantity was found between 1753 and 1763, and since that time it has always been on the decrease. According to the incomplete accounts which Eschwege was able to obtain, he calculated that the whole quantity of gold collected between 1700 and 1820 amounted to a million and three-quarters pounds weight avoirdupois or about 14,800 lbs. annually, including one-fifth which he thinks was smuggled out of the country. Between 1753 and 1763 it amounted annually to about 16,000 lbs., but between 1801 and 1820 only to 3,540 lbs. In the two last statements the gold smuggled out of the country is not included, and it may amount to more than one-fifth, at least for the latter period, when the means of communication had been greatly increased. The decrease of the produce was mainly owing to the better portion of the auriferous sand having been exhausted, and to the want of sufficient capital to work the veins in the mountains on a regular system. British capital has since been employed with success, and the productive mines at Gongo Soco, near the Villa de Sabara, on

the banks of the Rio das Vellias, a tributary of the Rio de St. Francesco, have been the reward of British enterprise.

Other parts of South America supply also gold to some extent, but that of Mexico and some other districts is mixed with silver or iron, and generally in the sulphurets of these metals; such mixtures, though exceedingly poor, sometimes repay the cost of extraction, as in the case of the silver of Guanaxuato, which contains only $\frac{1}{360}$th of its weight of gold.

Oaxaco contains the only auriferous veins worked as gold-mines in Mexico they traverse rocks of gneiss and mica-slate.

All the rivers of the province of Caracas to 10° N. of the line, flow over golden sands.

Peru is not rich in gold ores. In the provinces of Huailas and Pataz this metal is mined in veins of quartz variegated with red ferruginous spots which traverse primitive rocks. The mines called Pacos de Oro consist of ores of iron and copper oxides containing a great quantity of gold. All the gold furnished by New Grenada (New Columbia) is the product of washings established in alluvial grounds. The gold exists in spangles and in grains, disseminated among fragments of greenstone and porphyry. At Choco, along with the gold and platinum, hyacinths, zircons and titanium occur.

The gold-washings of El Mineral de Veraguas in Central America, near the Caribbean coast, have been once very productive, and are still the most important on the Isthmus of Panama; these washings have been worked since the Spanish conquests. Towards the end of the last century some of the Spanish creoles obtained from the unexplored ravines, or rather from the bottom of gullies, which had been filled-up by the accumulation of sands, upwards of 20lbs. of gold weekly for some months, and lumps weighing many pounds. Even during the years 1800 and 1804 there were introduced into the provincial treasury from the river Conception and its branches, 2,067 lbs. to pay the 3 per cent., being 3 per cent. of the produce of these washings. Since then, however, like many other gold-washings the great deposits have been exhausted—the present washers are limited to the daily decomposition of the granitic mountains. It is not impossible but there may be still undiscovered filled-up ravines, the usual golden stores which some fortunate individual may yet meet with in that neighborhood. All the gold is in coarse grains, and of a high standard, and is produced by granite containing the brightest yellow mica.—*Calvert.*

WORKING FOR GOLD.

The rich little samples and surface specimens of the Turon, Tambaroora, and Louisa Creek quartz, might be worked to pay a very large profit, by adopting the old Mexican mill, which has often been erected in California at an outlay of from 30 to 50 dollars; and the whole establishment might be carried on by a man, a boy, and a mule.

These rough mills have been used by working-men, with great profit, to work up rich surface, straggling blocks of quartz, or the backs of the veins near the surface. Depend upon it, they never left a vein so long as visible gold was to be found; when they had finished with a vein, it used to be said, quoting the American expression, "that then it was exactly in a fit state for a company of Britishers," or, in other words, a London gold company, with all its appurtenances of manager, directors, chairman, sub-managers, solicitors, bankers, engineers, clerks, captains, and such a host of officials, too tedious to name, which the gold-seeking public were made to believe were all to be paid out of the hard, solid quartz rock. The argument in favor of the quartz paying this magnificent staff, instead of the shareholders, was generally based upon some small piece of quartz knocked off the corner of a vein where it cropped out of the ground (which is generally the richest spot from which to obtain a specimen in quartz veins carrying no other metal), which, being divided into still smaller pieces, is sent to the most celebrated assayists. There the thousandth part of a grain is nicely calculated, and the average per ton is

sent in to the worthy promoters, who, being men with a smattering of accounts, after several hours of consideration and calculation, are quite astonished at the enormous amount of their own figures. For instance, suppose the specimen (less than 1 oz.) gives at the rate of 17 ozs. 11 dwts. 18 grs. per ton, then what is the whole mountain worth? The result is very seldom printed, but is confidentially gone over with each shareholder separately; or he may take the figures home, and calculate them over with his friends, some of whom, it is not improbable, may be seen going towards the city next morning.—*Corresp. London M. Journal.*

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

Since our last number the reports from the Lake Superior region have become quite flattering.

The accounts from the mines show a steady increase of production. Many mines that were considered doubtful at the commencement of the season have been worked, and developed, showing that they were worthy of the confidence of the public. The amount already sent below exceeds 3,000 tons. It is worthy of note that most of the copper sent below this season, yields a greater per cent. of ingot copper. For example, the shipments from the Copper Falls Mine for 1854 averaged only about 45 or 55 per cent. pure metal, while this season, the average has been 88 to 96 per cent. This is a gratifying feature in the present system of mining, showing that more attention has been paid to the separation of the copper from dross, thus securing a greater return for the labor and money invested. The same plan has been followed by most of the mines during the present season. In consequence of this, the yield of pure copper has been much greater even than the increase of shipments, in gross. The various companies are prosecuting the work as fast as possible, the only drawback at this time being the lack of men. We may safely estimate the amount that will be got out during the coming winter at double the quantity of any preceding winter. The tendency of the stock market is in favor only of those companies that are doing a steady business. This, though it may tend to discourage the weak mines, even where the locations are good, will in the end prove to be the best thing for all, as each one will rest upon its own merits and not any fictitious position. There is some complaint about the scarcity of money among the business men up the Lake, which may be owing to the fact that a far more important article, supplies, is being sent forward from the ports below. The ensuing winter can hardly be other than one of general prosperity in the Upper Peninsula, and necessarily leave it in the spring in a position where it cannot be so easily affected by monetary matters. We notice a large number of mines among the shippers; among them is the Central. The Pewabic has made another shipment, showing a fair prospect for limited workings. As soon as the means necessary to develope the lode are received, this mine will take a stand among the first in the country. Portage, and Isle Royale mines are well represented. The latter increasing its good prospects. Those old standards, the "Cliff" and "Minnesota," still keep at the head of the column.—*Journal.*

MINES NEAR GOGEBIC LAKE.

We are pleased to learn that the mines in the Gogebic District are to be worked vigorously the coming winter.

The Metropolitan Mine has lately been visited by a committee of its directors, who have laid out a plan of work for a large force. They will erect a saw-mill on the West Branch of the Ontonagon, where it passes through their grounds; which will also benefit the neighboring mines with a supply of lumber.

The Gogebic and Magnetic Mines are to resume work this fall. They are the pioneer mines of this district; and we are assured by the agent that the vein which they have worked, is as promising as any in the country.

In the shaft of the Magnetic which is down 140 feet, the lode is 7 feet wide, well charged with lump copper and stamp work. The same vein is worked on the Gogebic, at a distance of one mile, and in the shaft which is down 90 feet the lode is 8 feet wide, and equally rich in copper. All that is wanted in these mines is a vigorous prosecution of the work. The experience of the country shows that masses are seldom found by merely sinking. It is by driving and stoping only that the character of a lode can be ascertained.

The Merryweather Mine, which is situated on the west side Gogebic Lake, is being worked with a good deal of vigor, notwithstanding the greater distance in the interior. They have lately extended the Gogebic road to their location; and their supplies will be hauled this winter from the Ontonagon.

We are informed they contemplate next year making the mouth of the Black river their shipping port, which is only eighteen miles from the mine, and the ground admits of a good road.

The vein, which is from three to five feet wide, has already been traced for a distance of four miles, showing the greatest regularity in its course and character.—*Miner.*

EAGLE RIVER MINES.

From a gentleman just returned from Eagle river, we learn that the mines in that district are looking exceeding well. The Northwestern mine is working a force of ninety men, all told, thirty-eight of whom are miners. They are running sixteen heads of stamps, and expect to ship the present season about ninety tons of copper.

At the Central mine the indications are of the most favorable character. The first work done on this location was commenced about the 15th of November last, since which time the mine has continued to improve in appearance and richness, and it is confidently expected by the Agent that seventy-five or eighty tons of mass and barrel copper will be raised from it the present season.

ONTONAGON MINES.

There is a great deal of animation among the mines in the Ontonagon district, and the indications of a profitable investment never looked more encouraging than now.

The Adventure mine raised, during the month of August, nineteen tons and seven hundred and fifty-two pounds of copper, with a force of sixty-four miners. This mine is worked upon the tribute system, the miners receiving $120 for each ton of copper raised by them, and we understand this percentage enables them to make good wages. The success attending this system of mining, has induced other mines, situated on the Evergreen Bluff, to adopt the same policy, and we expect soon to learn of further developments there.

The Merchants' mine, adjoining the Adventure and on the same bluff, are working a small force on the tribute system, but with what success remains to be seen, as the party engaged have but just commenced operations, and not yet had time to try their fortune.

Mr. Moyle, of the Nebraska, informs us that that mine is increasing in its prospects every day. They have lately commenced the sinking of a new shaft on top of the bluff, with the most gratifying results.

This is one of our young mines, and for its age has done remarkably well. It is but about two years since operations were commenced here, and in that time over twenty-five tons of copper have gone forward as the product of the mine, and in addition to which the agent intends shipping the present season from four to six tons more. There has been several very fine specimens of silver taken from this mine, and we were shown one a few days since nearly as large as a hen's egg, and quite pure.

It is a settled fact that the Minnesota mine, which declared a dividend of $30 per share last year, will have raised 100 per cent. more copper the present season, at an increase in their expenditures not exceeding 20 per cent.; which will enable them to declare increased dividends to stockholders.

The Toltec have succeeded in conveying their mammoth engine from Ontonagon to the mine, and are busily engaged in putting it in place. When once in operation, and the new Tram road to the stamp house finished, its friends may look for good accounts from there. Speaking of the value of the copper raised from this mine, the mining Chronicle says:

We learn that a small lot of No. 2 stampings taken at random from a barrel of cleansed copper at the "Toltec" mine, has been found by Dr. Hayes to contain a handsome percentage of silver, say at the rate of 10 or 12 lbs. of silver to the ton of copper. Two whole barrels of the same class of copper, since received, have been sent to the assayer. Silver has been noticed in much of the "Toltec" product, but the percentage has been considered too small to be profitably extracted. Should the handful submitted to Dr. Hayes prove to be a fair sample of the mine product, the stockholders will rejoice, as the ton of metal will be worth $700.

The North Star, which arrived here yesterday morning, brought among her passengers the President and some of the Directors of the Ohio Trap Rock, and some of the officers of the Ridge Mining Companies. These two mines suspended payment several months since, and have labored under great disadvantages in consequence. We understand, however, that it is the intention of the Companies to immediately settle up their indebtedness, and proceed to work them with vigor in future.

The Agent of the Ridge informs us that with the means necessary to cancel their present indebtedness. this mine is capable of self support.

ST. MARY'S SHIP CANAL.

The total receipts and expenditures of the canal from the 18th June to the 30th September, inclusive, are as follows:

	RECEIPTS.	EXPENDITURES.
June,	$390 81	$252 21
July,	830 24	919 21
August,	990 72	860 99
September,	756 88	779 83
Total	$2968 65	$2812 24

Showing the balance of $156 64. It will be remembered, that a large item in expense account of the canal at this time is the payment of some debts contracted in the early part of the season for machinery fixtures, &c.

These are being reduced as fast as possible and will probably be cancelled during the current year.

NORWICH MINING COMPANY.

The following are the reports of the Secretary of the company and the Agent of the mine, made to the stockholders relative to their property. This enterprise is beginning to assume a very promising aspect:—

Frequent inquiries respecting the condition and future prospects of this

company, having recently been made, the directors have thought proper to make the following statement to the stockholders.

On the 27th of March last, a circular was issued to the holders of shares in several of the mines of the American Mining Company—among them the "Norwich Mine"—informing the holders of shares in that mine of the organization of this company, and the purchase of said mine from the American Mining Company, and stating the terms upon which the shareholders in that mine could become subscribers to the stock of this company. In compliance with those terms, nearly all the shareholders in said "Norwich Mine," surrendered their certificates, and took an equal number of shares of the stock of this company—paying the call of \$2.00 per share which was demanded. The holders of only 120 shares have failed to do so, and they are parties who either are absent from the country, or whose residence is unknown, and it is believed have never received notice of the new organization.

Early in the spring, the directors despatched one of their number, Israel Coe, Esq., to the mine, with funds for the payment of the miners employed, and other claims at the mine and vicinity—thereby releasing the copper that had been raised during the winter, and which, having been pledged for the payment of these debts, could not be shipped until they were discharged. He was also instructed to examine into the condition and prospects of the mine, and make a report to the directors. This gentleman has returned and submitted his report, which is appended hereto.

It will be seen from the report of Mr. Coe, that during the winter of 1854-5, there was taken from the mine 145 tons of copper ore. This has all been shipped to Detroit, to be smelted. A portion of it has passed through that process, and has been received in New York, and sold. More is now on the way, and the remainder will be forwarded soon, and when sold the proceeds will be applied to the liquidation of debts against the "Norwich Mine," which were assumed by this company when the mine was purchased. In addition to the ore above alluded to, about 80 tons have been taken from the mine since the opening of navigation, a portion of which has been already shipped. The agent at the mine expects to get out enough more, before the close of navigation, to make the shipment for the present season, 200 tons—and present indications fully warrant that expectation.

The number of men employed in and about the mine, at the present time, is not far from 120. A larger force will be put to work as soon as sufficient ground is opened to admit of their being employed to advantage. It is the policy of the directors to push the work on this mine with vigor and energy, with the desire to make it remunerative to the stockholders at as early a day as possible. How soon that will be, they do not desire to predict, as so many representations to that effect have heretofore resulted in disappointment; and they have no intention to hold out inducements and expectations which may not be realized. One great difficulty with mining companies generally, is that of undertaking to operate and develope a mine with an insufficient capital. A mine will yield returns to its stockholders much sooner and much more abundantly, if a sufficient capital is employed at the outset in properly opening it, than if undertaken with a smaller amount of means.

In the circular of 27th March, before referred to, it was stated that the debts existing against the mine, were estimated to amount (not including \$15,400 bonds due in 1857), on the 1st of April, to

	\$70,000
Add to this sum the expenses of operating the mine since that time to 1st instant, four months, say	15,000
	\$85,000
Deduct for claims which have been paid off with funds received from the call of 11th May, and from sales of copper	44,000
Leaving the amount of outstanding debts, due on 1st inst., about	\$41,000

which will be liquidated as fast as funds are received from further sales of

copper. This amount of indebtedness is necessarily partly estimated, as from the nature of some of the debts, the *exact* amount cannot now be ascertained, but it is confidently believed that it will not, in any event, exceed this sum.

Owing to the early closing of navigation on the Upper Lakes, it is necessary to send forward the requisite supplies for the winter, as early as the month of September. Believing it to be for the interest of the company that the supplies should be purchased for *cash*, the directors, on the 24th of July last, levied an assessment of one dollar per share, payable on the first day of September. As some funds were required immediately at the mine—before any could be realized from sales of copper or payment of this assessment—it was determined to make a deduction of two per cent. on all payments of this assessment made prior to the 15th day of August. A large proportion of the stockholders have availed themselves of this privilege, and payment was made before the 15th instant, on 11,967 shares. It is earnestly hoped that *all* will *promptly* respond to the call, as thereby the company will be enabled to make the necessary purchases of supplies to much better advantage, and prosecute the work at the mine with a greater degree of vigor.

Numerous inquiries have been made as to whether further assessments will be required. In reply, the directors would say, that in all probability another one will be necessary in the ensuing spring, as, however much copper may be produced during the winter, it will be wholly unavailable until it is smelted and got to market, late in the season. In the mean time funds will be required to meet the expenses at the mine, and also to procure an engine for hoisting the ore and pumping the water from below the adit level, in which direction the mine will hereafter be worked. Experience in other mines has proved that the lower they have been worked, the more productive they have been. An assessment may possibly be required sooner than the time named.

Recent accounts from the mine represent it as constantly improving, and promising well for the future. There is more copper now in sight than there ever has been at any previous time, and the directors feel much gratification in being able to predict, that the day is not far distant when the "Norwich" will take rank among the few dividend-paying mines. Disinterested parties who have visited it the present season, speak of it in the highest terms, and pronounce it as "second only to the 'Minnesota' in the Ontonagon district." A plan is submitted herewith, showing the extent to which the mine had been worked on the 1st of July.

E. M. LIVERMORE.

To the Directors of the Norwich Mining Company.

Having been appointed an agent to visit the mine for special purposes, and having performed that duty, I beg leave to make the following report:

I left New York on the 18th, and arrived at the mine on the 28th day of May, in company with Nath. Hayden, Esq., who was charged with a like agency to the Windsor Mine.

The Norwich Mine is located in a high hill or bluff, rising about 800 feet above the road which extends along near its base, and is well situated for mining advantageously. This mine was discovered in July, 1846, by a party of the American Exploring, Mining, and Manufacturing Company, of which Mr. Davis, the present agent, was one. They continued in possession, and by an Act of Congress passed in March, 1847, Mr. Davis was enabled to enter a section of land which was subsequently divided, equally, between the Norwich and Windsor Mines. On the day they discovered it, two masses of copper were taken out, one of 110 and one of 12 pounds. Very little however was done, except exploring the location, until August, 1850, when a small force was employed to commence mining; but they were under the necessity of erecting dwellings, clearing land and cutting out roads, and until the fall of 1851 and winter following, but a small amount of mining was accomplished. He had then increased his workmen to about thirty, and in the spring follow-

ing he sent forward 5 tons copper, and in 1853, 24 tons, and in 1854, 18 tons were shipped, making in all up to that time, 48 tons, yielding about 65 per cent.

The mine increasing in richness, producing considerable amount of stamp work, it was deemed advisable to erect stamp works; and an engine and other machinery were procured for the purpose, and also for a saw-mill, which was forwarded late in the fall of 1853. On the 4th of May, 1854, eight heads of stamps were set in motion, and not long after, eight more were added.

About this time, owing to the financial difficulties of the country, and other causes, the company became embarrassed, and were not able to supply the agent with money to pay his men, or meet their acceptances—consequently a large amount of their paper was under protest, which very much impaired their credit and crippled their operations to considerable extent; still they succeeded in procuring a tolerably good supply of provisions, which after much effort by Mr. Davis, were by the last boats up the lake, delivered at Ontonagon. But for his untiring perseverance, and substantial aid and assistance rendered by some special friends of the company, the operations at the mine would have been stopped.

During the last year they had but very little money to pay the workmen, but the mine was yielding quite an amount of copper, which being pledged by the agent for the payment of their wages, they continued to work, though at times they were dissatisfied, and made him a good deal of trouble. He however managed to quiet them, until I arrived at the mine with money to pay them off.

The indebtedness at the mine and vicinity, when the Norwich Mining Company, formed under the mining laws of the State of Michigan, took possession of the property purchased of the old company, on the 1st April, amounted to $33,821 13; but on the 1st July was, with an addition of three months expenses of the mine, reduced to $21,736 84.

The property of the company consists of 320 acres of land, on which the mine extends across the north end, and the half of 640 acres, owned jointly with the Windsor Mining Company, purchased for a meadow. About 100 acres of the first mentioned piece has been mostly cleared, and 65 under cultivation.

The buildings are an office, store, two boarding houses, ten small dwellings, smith shop, coal and change house, carpenter shop, copper house, barn, powder house, stamping house, and saw-mill. A new house is about to be built for the agent and other officers of the mine—materials being mostly on the ground for the purpose.

The value of the property on hand, as estimated on the 1st of April, is as follows:

640 acres of land at first cost, ...	$800
Estimated cost clearing 100 acres, ...	2,256
Goods in store, supplies, tools, furniture, 1000 cords wood, wagons &c.	12,557
Oxen, horses, cow, hogs, &c., ...	1,010
Steam engine, stamps, and saw-mill, ...	8,000
Estimated cost of all other buildings, ...	5,485
	$30,408
Add 145 tons copper, estimated	50,000
	$80,408

The work done at the mine, as shown by actual measurement:

Shaft A has been sunk 150 feet; B, 340; C, 45; D, 60, and E, 70 feet—in all		665 feet.
Adit level to shaft B, has been driven 500 ft.		
Two other adits, ...	200 "	700 "
Level No. 1, 225; No. 2, 430; No. 3, 645, and No. 4, 180 feet .		1480 "
Two winzes, ...		107 "
Amount of stoping, ...		1434 fathoms.

Adit level to shaft B, enters the base of the bluff on a line of the road, and all the rock and masses taken out and the mine drained through that channel, and what comes from below this adit is drawn up to it by a whim worked by a horse, which thus far is all the force required for hoisting and pumping; but when another level is attained, an engine will be required, which will probably be during next season.

The stamps are at a convenient distance from the mine, and are sufficient to stamp all the rock raised at present. They produce about half a ton copper to each head per month, which is about an average production at other mines.

The mine from its first opening, has increased in richness as the work has progressed. Masses have been taken out from almost every part of it. The vein is large, very regular, producing also barrel and stamp work of good quality. The Windsor Mine, half a mile east, is a continuation of the same vein, which is quite as promising as the Norwich, at the same stage of work.

During the last year, and up to 1st April, they have taken out and shipped 145 tons of copper—62 tons of it in masses, 117 in number, weighing on an average over 1070 lbs. each—balance in barrel and stamp work. Mr. Davis feels confident he can make the shipment up to 200 tons before the close of navigation.

It is his intention to extend shaft B to another level, and also work the levels east and west, for the purpose of proving the vein and opening more ground for stoping, preparatory to an increase of workmen the coming winter.

In regard to the future prospects of the mine, I have to remark, that under the present organization I have no hesitation in saying, I think it can and will produce copper enough to pay all its expenses for the coming year, and provided the shipment of copper is made up to 200 tons, with the present call of one dollar per share, there need be no further assessment made before next spring, when one more may be required, as they will not be able to realize the proceeds of their copper before August or September following, and an engine for hoisting and pumping may be required before that time. With that assessment I confidently predict, it will be all ever required before the mine will begin to repay the stockholders.

ISRAEL COE.

By-Laws of the Norwich Mining Company.

ARTICLE I.—The officers of this Company shall consist of seven Directors, a President, Secretary, and Treasurer, and such other officers as may hereafter be determined on. The President or Secretary may also be Treasurer.

ART. II.—Twenty days' notice of all assessments shall be transmitted by mail to each registered stockholder, and notice of each assessment shall be published in a New York and Detroit daily newspaper, at least twenty days previous to the time of payment.

ART. III.—Meetings of the stockholders may be held at such times as the President or Directors may appoint; and the President or Directors shall, on the written request of a person representing twelve hundred shares, call a special meeting. All meetings called by the President or Directors, shall be held at an office of the Company, and notice thereof transmitted by mail, to each registered shareholder, and published in a New York and Detroit newspaper, at least twenty days previous to such meeting.

ART. IV.—Meetings of the Directors may be held whenever and wherever they may determine, and any Director may call such meeting.

WINDSOR MINING COMPANY.

This Company, whose mine was formerly embraced within the list belonging to the American Mining Company, is now organized on an independent

footing. The following is the statement to the stockholders of the President and General Agent after an inspection of the mine:—

As directed by you, I visited the Mine, and proceeded to investigate and pay the claims against the old Windsor Mine, assumed by your Company, and it affords me pleasure to say, I found the accounts of the Agent, Mr. D. Plummer, in a satisfactory state, and the affairs of the Mine in a better condition than we had a right to expect, when it is remembered that the Agent had had no funds, and been almost totally neglected, for some eight or nine months.

I found, after investigation here and at the Mine, that the indebtedness of all kinds on the first of April last was	$26,167.28
The Inventory of Live Stock, Tools, Wood, Supplies, and Merchandise, was	$9,445.22
Cost of Land Improvements and Buildings	$8,565
And thirty-four tons of Copper at Ontonagon, estimated at	$11,900

Since Mr. Warner's Report in August, 1854, the Mine has been worked with as much force as the circumstances of the Company would admit of, and about thirty-four tons of Copper had been taken out up to the opening of navigation, since which time, Mr. Plummer has not thought it for the interest of the Stockholders to do any considerable amount of stoping, as, until the adit was connected with the Main Shaft, all the stuff had to be hoisted, at great expense, to the top of the bluff, only to be thrown down again when the adit was finished.

There was, on the first of this month, only fifty-eight men employed, viz:

22 Miners, 9 Helpers, 10 Surface Men, 17 Carpenters.

The work done in the mine thus far is as follows, viz.:

Shaft No. 1, or Main Shaft, which has been sunk on the course of the vein, on a cross course 265 feet, and is now deep enough to connect with the adit.

Shaft No. 2, west 110 feet from No. 1, has been sunk 216 feet. It is proposed to continue the sinking to the third level, which, it is hoped, will be accomplished before or by the time the third level can be driven to meet it.

Shaft No. 3, west 150 from No. 2, has been sunk 80 feet on the vein, to the first level. A small amount of work has been done on Shaft No. 4, west 530 feet from Shaft No. 1, but it is not considered necessary to continue it at present. The ground from the top of the vein to the adit level, is to be divided into three parts. The first level has been driven east 25 feet from Shaft No. 1, and 384 feet west from same point, cutting shafts Nos. 2 and 3. The second level commences 72 feet lower down, and has been driven 72 feet east from Shaft No. 1, and 378 feet west from Shaft No. 2. The ground between Shafts No. 1 and 2, on this level, it is proposed to stope from the third level. 205 feet west of Shaft No. 2, a winze has been driven from first to second level, and on each side of this winze all the stoping, thus far, has been done.

A short adit, 100 feet in length, has been driven in so as to intersect Shaft No. 1 at a depth of 48 feet from the surface, which drains the water from Shafts No. 1 and 2.

At the base of the bluff an adit was commenced in November, 1853, which has been driven night and day up to this time. It is a fine specimen of work, and when finished will be a credit to the workmen, who have toiled for nearly two years to complete it. It is nearly 600 feet long and I have just heard that the connection with Shaft No. 1 has been made. It will be the great highway of the mine, and there is ground enough above it, to take years to stope out.

When the mine is opened lower down, there will be so much less hoisting to be done, besides bringing all the Copper and Stamp work to one point. Now that the

adit is holed, all the men that can find room to work, will be set to driving, east and west on the third level, and every foot driven will give 260 feet of back to stope out. I hope that by the time cold weather sets in, the Agent will be able to set forty to sixty miners at work, and if so, we may reasonably expect a fair amount of Copper to be ready for shipment in the spring.

As the mine has progressed in depth it has, as a general rule, improved in richness. The Map of the Mine annexed only shows 600 feet, while the mine is 5280 feet long, and a glance at it will show the small space stoped out, as compared to the amount of ground that will be opened as the third level is extended east and west.

A contract has been made for a Steam Engine and Stamp Machinery. The frame of the Kiln house, and also one for the Stamp and Engine house are already up and the Agent, Mr. Plummer, is pushing the work forward as fast as possible, to get it covered in before cold weather sets in. The Engine has been shipped, and a part of it will be hauled to the Mine before snow falls, and the balance of the Engine and Stamp Machinery will be at the Mine as soon as the sledding becomes good, and it is believed the Stamps will be in operation in all the month of January.

A Railroad is being built from the Kiln House, near the mouth of the adit, to the Stamp House, a distance of near one-third of a mile, which it is expected will be completed by the time the Stamps are ready for work, by which the Stamp-Work can be conveyed from the Kiln to the Stamps at very small expense.

The expenses of the Company will be large this season, for purposes that will not immediately produce Copper, larger by far than they are ever likely to be again, but all necessary for the prosecution of successful mining; and it will be necessary to call an assessment, which I trust the Stockholders will promptly pay, as it is poor economy to attempt to carry on a mine without sufficient funds.

The following is the Treasurer's Report:

Dr.	
Paid on old account in New-York,	$9,676.44
" new " "	1,140.16
" N. Hayden, as Agent,	16,452.25
" Expenses,	498.99
Balance on hand,	3,462.61
	$31,230.45

Cr.	
By Cash for first call on 19,241 shares Stock, at $1.50,	$28,861.50
By net of note discounted,	1,953.00
" Profit and loss, received for interest, &c.,	415.95
	$31,230.45

New-York, August 30, 1855.

(Signed) JOHN WADSWORTH, *Treasurer.*

Examined and found correct,

(Signed) ELISHA PECK, NATH'L HAYDEN, } *Finance Committee.*

The financial affairs of the Company, this day, are as follows:

Due by old Company 1st April last		$26,167.28
Supplies and merchandise purchased since,		6,254.71
Wages, (partly estimated,) and expenses to date,	$9,217.83	
Less supplies had by workmen,	3,413.31	
		5,804.52
		$38,226.51
Paid by Treasurer and cash in his hands,		31,230.45
Due this day,		$6,996.06

A portion of the Machinery is not to be paid for before next May, but I estimate the extra amount wanted for payments on Machinery, Stamp-Buildings, Railroad, &c., before the close of the navigation, at . . . $ 7,000

Cost of merchandise and supplies,	15,000
Wages of men to 1st of January next	15,000
Now due, about	7,000
	$44,000
Less net proceeds for Copper	12,000
Balance,	$32,000

A portion of the above will not be wanted before towards Spring, and a part of the amount for wages will be paid in merchandise and supplies, but it will be necessary to have some $20,000 immediately, to pay men and purchase such supplies as can only be purchased advantageously for cash. I therefore recommend the call of an assessment of One Dollar per share on the stock, payable on or before the first day of October next, which amount, I trust, will carry the Mine up to some time early next Spring.

In making this report, I have omitted all estimates of the amount of Copper that will probably be taken from the Mine this season, as all such estimates are usually very erroneous. I have only given the facts, leaving each one to form his own opinion. I would only say that, thus far, few mines have produced as many pounds of Copper for the same number of feet stoped, as the Windsor.

NATHANIEL HAYDEN.

THE PROSPECTS AT LAKE SUPERIOR.

The following glowing account of the anticipations in the Lake Superior region for the next year are worthy of perusal. We hope these prospects will all come to pass.

It is now a settled fact, that the business of the Upper Peninsula for the year 1856 will be nearly or quite double that of the present year, provided that no unusual depression in the monetary world intervenes. The various Mining Companies in the Copper region are actively engaged in the work of getting out Copper, for shipment, and instead of contracting their forces as winter sets in, contemplate an increase. This will of itself afford a large amount of freight for Propellers next spring, and indeed for a large part of the season. The energy which is manifested by those in charge will be seen in the greatly increased amount of Copper made ready for shipment. We are confident that another season will bring out mines as dividend payers, which now are calling for assessments. Among those which were affected by the difficulties of last winter, there is a large number that will be in a position where the fluctuations cannot affect them. The fact that the management of the different mines are now pursuing their business in a legitimate manner, expending money and labor upon their locations, and striving more to develope the resources of their mines, than to sell the stock, is a sufficient guarantee to the Stockholder that his money is not invested in any groundless enterprise. All these things betoken a good time coming for our Lake Superior Copper Mines, and it is the opinion of those best informed on this subject, that the coming season will be one of unexampled prosperity in the Copper District.

The Iron Mining and Manufacturing Companies are not behind their brethren of the Copper range in the work of getting out this valuable mineral. Possessing superior advantages for quarrying, and facilities for shipping, they are making preparations for the coming season, in keeping with the vast extent of their mineral deposits. The fact has been demonstrated that the Iron can be manufactured on the spot, and the Companies are busily engaged in perfecting their arrangements. Another branch of the business, the shipping of Ore, will

become an important item in the trade of Lake Superior. We do not doubt that so soon as the roads are finished from the mines to the Lake, that a market will be found for all the ore that can be shipped. These Companies are working on a safe and sure foundation, and rank among the solid and substantial corporations of the Union. A fair return for the money invested is all that is expected, and this they bid fair to realize.

The Fisheries, Stone Quarries, etc. of the Upper Peninsula, are beginning to attract the attention of business men, and the prospects are that they will be entered into more extensively than heretofore. This part of the wealth of Lake Superior has been somewhat overshadowed by the mineral mania, but the increase of population and the activity in all parts of the country has caused them to be the subject of much inquiry.

The facilities for transit from point to point, will be much greater than heretofore. In addition to the present lines of steamers, a new line will be put on between Chicago and the head of the Lake; another is in contemplation to run from Superior to Collingwood, and the old lines will put on more propellers. These will be sufficient for any business that can be done, and will bring the various ports on Lake Superior in direct connection with all the important points on the lower Lakes.

All in all, the prospects for the coming season are of a character to afford the greatest satisfaction to those interested in the country, and we hope that the present indications of prosperity may not be overshadowed by any unwise or impolitic acts of those who represent their interests.—*Journal.*

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

	Tons.
Shipments by Reading Railroad, to October 18th,	1,952,558 15
" Schuylkill Canal,	893,047 13
Total.	2,845,606 08
To same time last year,	2,516,034 17
Increase thus far in 1855,	329,571 11

LEHIGH COAL SHIPMENTS TO OCT. 18TH.

Summit Mines,	266,891 11
East Lehigh,	88,230 00
Room Run Mines,	64,662 00
Beaver Meadow,	86,104 00
Spring Mountain Coal,	146,068 07
Colerain Coal,	80,076 11
Stafford Coal,	8,149 14
East Sugar Loaf Company,	41,958 11
New York and Lehigh Company,	81,516 18
French American Coal Company,	6,678 13
A. Lathrop's Pea Coal,	2,594 16
Hazelton Coal Company,	182,332 02
Cranberry Coal Company,	67,488 09
Diamond Coal Company,	26,047 03
Buck Mountain Coal,	69,219 12
Wilkesbarre Coal Company,	39,172 04
Wyoming Company,	656 18
Total,	1,054,870 15
Last year,	986,769 00
Increase in 1855, so far,	68,101 15

MARYLAND COAL TRADE FOR 1855.

	Tons.
Total to October 18,	518,021.04

INCREASE OF SHIPMENTS OF COAL.

On this subject the Pottsville Journal states the following facts:—

The increase from the three principal Regions now stands as follows, October 18th:—

Schuylkill,	295,729
Lehigh,	67,203
Lackawanna,	240,000
Total,	602,932

The increase and decrease from the other Anthracite Regions, will about balance each other.

Last year there was an increase of 200,000 tons of Bituminous and Semi-bituminous Coal thrown into the market. This year there will be no increase of these kinds of Coal, but in all probability the supply will be about 50,000 tons less than last year. The Cumberland Region is behind the supply of last year, and the Dauphin and Susquehanna Company, which mined 63,000 tons last year, will not mine 10,000 tons this year.

SHIPMENTS FROM MARYLAND.

Mining operations in the Maryland coal region have not been so active this year as they were last. The amount sent and to be sent this year will fall short of the shipments of last year near one hundred thousand tons. This falling off in the trade is attributable to several causes, which will be briefly named. In the first place the demand has been extremely limited, not at all keeping pace with the ability to supply. This was owing to the stringency in the money-market in a great measure. The manufacturing establishments north and other places where this fuel was mainly consumed, were compelled to suspend operations. In addition to this, a portion of the ocean steamers were chartered by the allied governments to carry troops and munitions of war to the Crimea, and withdrawn for that purpose. This cut off a large amount of sales.

The introduction of Pictou coal, under the Reciprocity Treaty, free of duty, has also curtailed our sales, as it is the only coal that comes in competition with Maryland coal. Causes like these, and an almost total loss of confidence in the judicious management of the Chesapeake and Ohio Canal, have combined to produce the diminution in the shipments of coal this year. It strikes us that these are the main causes.—*Cumberland Telegraph.*

LEHIGH VALLEY RAILROAD TOLLS.

The rates of toll and transportation upon Coal from Mauch Chunk to Trenton, via Belvidere & Trenton Railroad, and to Newark via. the New Jersey Central. and New Jersey Roads, and to Elizabethport via. the New Jersey CentralRail Road, in connection with the Lehigh Valley Railroad is as follows:

Lehigh Valley Road	2½ cents per ton, per mile,	Way trade
" " "	2¼ " "	Through "
New Jersey Railroad	2½ " "	" "
New Jersey Central	2½ " "	" "

		$ cts.
Total from M. Chunk to Trenton		2 06
" " "	to Elizabethport,	2 63
" " "	" Newark,	2 71
" " "	" Easton,	1 06
By Canal, "	" Trenton,	2 04
" " "	" Elizabethport,	2 82
" " "	" New Brunswick,	2 55
" " "	" Newark,	2 82
" " "	" Easton,	1 03

The Railroad has an advantage of about ten cents per ton in cost of transshipmen t.

The rates are nearly equal. If any preference is discernible, it is in favor of the Railroad affording speedy transit, and quick returns.

The payment of Railroad tolls and transportation is, invariably, *cash on delivery!*

This arrangement cannot, however, affect the business of this season. It will enter into the calculations in fixing tolls and freights the coming season. by canal.—*Gazette.*

THE PHILADELPHIA AND READING RAILROAD.

The last annual report of this company contains many important facts relative to the transportation of coal. It will be found to present these remarkable results during the year 1854.

An increase in Coal transported of .	405,606	Tons,	equal to 25	per cent.
" Merchandise . .	82,948	"	" 30	"
Passengers . .	54,812	"	"	"
Or, through passengers,	12,562		" 13	"

An increase in the gross receipts from the transportation of Coal of . .	$999,123 61	or 44	per cent.
" Merchandise . . .	51,014 89	" 28	"
" Passengers . . .	46,604 61	" 20	"

An increase in the net profits from the transportation of Coal of	$667,968 87	or 47	per cent.
" Merchandise . . .	16,095 78	" 24	"
" Passengers	28,704 84	" 13	"

This comparison is made from the working of the road in these three departments, without reference, of course, to Renewal Fund, Drawbacks, Miscellaneous Receipts, &c., which would but slightly vary the result. To attain entire accuracy in the statement of the revenue from these three sources, it is necessary to estimate the proportion of Renewal Fund, &c., chargeable to each. The exact statements are as follows:—

1854.	Gross receipts from all sources . . .			$3,781,639 91
	Deduct all expenses and drawbacks,		1,641,212 94	
	Renewal Fund, On same basis as in 1853,		129,988 76	
				1,771,201 70
				$2,010,438 21
1853.	Gross receipts . . .		2,688,287 59	
	Deduct all expenses and drawbacks . .	1,222, 537 52		
	Renewal Fund .	106,974 23		
			1,329,511 75	
				1,358,775 84
	Increase in the net profits of the road in 1854 over those of 1853,			$651,662 37

NUMBER AND POWER OF LOCOMOTIVES USED.

The following Table presents the number and power of the Locomotive Engines now, as compared with Nov. 30, 1848:—

	1st Class.			2d Class.			3d Class.			4th Class.			Total.		
	No.	Tons.	Cwt.	No.	Tons.	Cwt.	No.	Tons.	Cwt.	No.	Tons.	Cwt.	No.	Tons.	Cwt.
On hand 30th Nov. 1848,....	47	999	6	26	341	16	8	71	10	3	14	8	84	1,427	
Sold or abandoned from that Date to 30th Nov. 1854 ..	5	100	14	11	136	8	3	27	8	1	5	3	20	279	13
	42	898	12	15	205	8	5	44	2	2	9	5	64	1,147	7
New Engines from Renewal Fund	22	503	16							1	14		23	517	16
	64	1.402	8	15	205	8	5	44	2	3	23	5	87	1,665	3
Bought and charged to capital account—															
In 1851	2	50	6												
In 1852	13	344	2												
In 1854	19	512	5												
Nov. 30, 1854	98	2,309	1	15	205	8	5	44	2	3	23	5	121	2,581	16

November 30, 1848, 84 engines weighed 1,427 tons = 17 tons, average weight.
" " 1854, 87 " " ·1,665,8 tons = 19 tons 11 cwt. "
Tons 1,665 8 equal to 98 engines of 17 tons weight.
On hand 30th Nov. 1848, 84 "
Locomotive power since 1848 has been increased out of the Renewal Fund equal to 14 engines of the average power of that date.

INCREASE OF CAPITAL AND CAPACITY OF THE WORKS.

	Capital and Debts.	Tonnage, Freight and Passengers.	Gross Receipts.	Net Profits.
	$	Tons.	$	$
1849	16,825,032 00	1,198,062	1,368,590 59	901,807 44
1850	16,825,832 00	1,461,168	2,368,958 50	1,167,292 76
1851	16,649,515 48	1,771,670	2,814,880 40	1,010,089 96
1852	17,141,987 47	1,796,260	2,490,626 41½	1,121,486 74
1853	17,905,018 77	1,782,758	2,688,287 59	1,885,492 18
1854	18.464,114 64	2,233,874	3,781,629 91	2,010,438 21
		10,243,792	15,562,488,40	7,546,507 24

An increase during the six years in Tonnage . . 86 per cent.
" " Gross receipts . 94 "
" " Net profits . . 122 "
" " Capital and Debts, 18 "

Thus it conclusively appears that this comparatively small increase of capital has not been expended for the purpose of perpetuating works then existing, which were represented by the then Capital, but in the acquisition of new, most valuable and profitable property, which otherwise has no representation at all in the capital stock. This increase also includes much valuable real estate not yet improved or used, of a present value, for any purpose, greatly beyond its cost, and of immense prospective importance to this Company. Reference is here particularly made to the river front at Richmond, and the property adjoining, not yet improved.

Transportation Department.

The entire practicability of using *anthracite coal* as fuel for locomotives, for long as well as short distances, may now be considered as fully established by

our daily experience. Eighty-five per cent. of all our coal transportation, during the past year, has been done by locomotives burning this fuel exclusively, and without experiencing any difficulties beyond the control of the engineer or fireman.

The gradual substitution of coal for wood in more of our engines, and the probable continuance of the recent decline in value of materials and labor, will enable us to secure a marked reduction in the expenses of this Department for the ensuing year.

Roadway Department

Has cost for the past year, $220,209 51—the increase over the expenses of 1853 having been caused by, and proportioned to, the increase of business.

The repairs of West Branch Stone Bridge, injured by a heavy freshet, and the construction of eight small wooden bridges, with the rebuilding of Norristown Water Sation, are all included in the above sum.

Renewal and Construction Departments.

RAIL ROAD IRON.

New rail road iron used in year,	2,272.77 tons	$156,280 70
Less old iron removed,	1,686.95 "	79,226 62
	Net cost of new rails,	$77,004 08

NEW TRACKS.

9.28 miles of new main track have been laid during the year; and 4.99 miles of sidings—for passing coal trains, and for the increasing business of the road in coal, iron, and other freight.

Business for the Year ending November 30, 1854.

TONNAGE.

Coal transported, tons of 2,240 lbs.	1,987,854
Merchandise transported, tons of 2,000 lbs.	140,801
Materials for use of Road, including earth, gravel, timber, rails, sills, cord-wood, stone, brick, iron, &c. &c., in tons of 2,000 lbs.	187,591
Total tonnage of Road for the year, including weight of passengers, in tons of 2,000 lbs.	2,582,568
Total amount of Coal transported to date, tons of 2,240 lbs.	14,610,286
Total tonnage of Road to date, tons of 2,000 lbs.	19,144,275

PASSENGER TRAVEL.

Total number of passengers during year	266,631
Total number of miles travelled by same	9,680,292
Equal to in through passengers over whole length of Road	105,219
Total number of passengers transported to date	1,704,643

RECEIPTS OF ROAD.

From freight and tolls on coal.	$3,253,822 78
do. freight on merchandise	231,626,69
do. passenger travel	272,367 94
do transportation of U. S. Mail, express car, and other sources	23,822 50
Total receipts,	$3,781,639 91

Number of Engines and Cars, and Running Machinery, November 30, 1854.

LOCOMOTIVE ENGINES.

98 First Class Engines.
16 Second " "
4 Third " "
3 Fourth " "

21 total.

COAL CARS.

1 Eight-wheeled Iron Coal Car.
215 " Wooden Coal Cars.
2,980 Four-wheeled Iron Coal Cars.
1,693 " Wooden Coal Cars.

4,889 Total

CARS FOR FREIGHT AND GENERAL USE.

05 Eight-wheeled Covered House Cars.
147 " Box Cars.
105 " Open Platform Cars.
186 Four-wheeled Covered House Cars.
371 " Open Platform, Box, and Dumping Cars.

814 Total

PASSENGER CARS.

34 Eight-wheeled Passenger Cars.
8 " Baggage Cars.
3 " Mail and Express Cars.

45 Total.

Items of cost, in detail, of running passenger trains for the year ending November 30, 1854.

USING WOOD FUEL EXCLUSIVELY, PER DAILY TRIP OF 96 MILES.

Items of Cost.	No.	Description.	Average Rate.	Amount.
Wages of engineer	1	Day		2 34
" fireman	1	"		1 30
" conductor	1	"		1 80
" baggage master	1	"		1 33
" brakeman	1	"		1 24
Wood for fuel, including firing up	2·8	Cords.	5·10	14 28
Water used	3	M. Galls.	6	18
Oil for engine and tender	0·98	Galls.	1·60	1 57
Oil and grease for cars				34
Repairs of engines	96	Miles.	11·1	10 66
" and refitting cars				9 63
Hands at depots, extra engines, &c.				3 92
Sundries for trains				2 50
				$51 08

Equal to, at 68·8 through passengers per train, 74·2 cents per passenger.

Items of cost, in detail, of running freight trains, for the year ending November 30, 1854.

PER DAILY TRIP OF 92 MILES.

Items of Cost.	No.	Description.	Average Rate.	Amount.
Wages of engineer	1	Day		3 00
" fireman	1	"		1 65
" conductor	1	"		1 75
" brakemen	3	"	1·50	4 50
Wood for fuel, including firing up	4·42	Cords.	4·96	21 92
Oil and tallow, for engine and tender				1 48
Oil and grease for cars	109·5	Tons	1·42	11 78
Repairs of engine and tender	92	Miles.	12·4	17 91
" cars	109·5	Tons.	16·3	19 81
Depot hands, and other depot expenses				30
Water used	5	M. Galls.	6	
Renewals of sundry articles, goods damaged, &c.				4 36
				$89 46

Equal to 81·7 cents per ton.

Items of Cost, in detail, of Hauling Coal, with Anthracite Coal and Wood Fuel, on the Philadelphia and Reading Railroad, for the year ending November 30, 1854.

Per round trip of 190 miles, from Coal Region to Tidewater, and back with empty cars; transporting average loads of 419 Tons with Coal, and 345 Tons with Wood Engines, respectively—

WITH ANTHRACITE COAL FUEL.

Items of Cost.	No.	Description.	Average Rate.	Amount.
Wages of Engineers	2	Days.	3·00	6 00
" Firemen	2	"	1·75	3 50
" Conductors	2	"	1·60	3 20
" Brakemen	6	"	1·55	9 30
Anthracite coal for fuel, including firing up	9·61	Tons.	3·44	33 06
Oil for engine and tender, including lamps	2·68	Galls.	1·20	3 22
Oil and grease for cars	419	Tons.	13	5 45
Repairs of engine and tenders	190	Miles.	14·4	27 36
" coal cars	419	Tons.	10·92	45 81
Supplying water	16	M. Galls.	6	96
Wood for kindling	5	Cords.	4·96	2 48
Assistant engines at Falls Grade	419	Tons.	1·35	5 66
Car couplers, timekeepers, dispatchers, and turning crews	419	Tons.	1·58	6 62
Allowance for engines laying over, assistant engines, and all other contingent expenses	419	Tons.	3·16	13 24
Equal to 39·58 cents per ton.				$165 86

WITH WOOD FUEL.

Items of Cost.	No.	Description.	Average Rate.	Amount.
Wages of Engineers	2	Days.	2·80	5 60
" Firemen	2	"	1·60	3 20
" Conductors	2	"	1·60	3 20
" Brakemen	6	"	1·55	9 30
Wood for fuel, including firing up	11·8	Cords.	4·96	58 53
Oil for engine and tender	2·01	Galls.	1·20	2 41
Oil and grease for cars	345	Tons.	13	4 48
Repairs of engine and tender	190	Miles.	12·9	24 51
" coal cars	345	Tons.	10·92	37 67
Supplying water	13	M. Galls.	·06	78
Assistant engines at Falls Grade	345	Tons.	1·35	4 65
Car couplers, timekeepers, dispatchers, and turning crews	345	Tons.	1·58	5 45
Allowance for engines laying over, assistant engines, and all other contingent expenses	345	Tons.	3·16	10 90
Equal to 49.47 cents per ton.				$170 68

SUMMARY.

4,036 trips by engines using coal fuel, at $165 86 — $669,410 96
860·55 " " wood " at 170 68 — 146,864 98
$816,275 89

AS PER STATEMENT C.

Average tonnage of all coal trains, during year 1854, 409 tons. | Average cost, per ton, of all coal transported, $41 . 06.

Comparative Statement of the number of Cars broken.

From July 1, to December 1, 1848, 1 car broken for every 1485 tons of coal carried.

In the year	1849,	"	"	2282	"	"
	1850,	"	"	2490	"	"
	1851,	"	"	3114	"	"
	1852,	"	"	3534	"	"
	1853,	"	"	2875	"	"
	1854,	"	"	3054	"	"

Of Total Expenses for Year, Coal . . . is charged with 59.30 cents per Ton.
Do. do. Merchandise do. 105.61 do. do.
Do. do. Through Passengers do. 112.22 do. Passenger.

Comparative Statement of the wear and breakage of rails from 1850 *to* 1854, *inclusive.*

Description of Iron.		Percentage of wear.					Proportion of breakage in 1854.
		1850.	1851.	1852.	1853.	1854.	
English 52 lbs.	light track.	1·3	2·6	3·2	4·5	7·8	1 bar in every 789
" 45 "		1·4	1·9	2·1	3·6	5·6	" " 14,241
" 60 "	heavy track.	8·3	9·4	12	12·7	18·3	" " 143
Phœnix 60 "		4·3	6·3	5·9	6·3	5·9	" " 423
Montour 60 "			1·7	6·1	8·2	5·9	" " 297

Statement of Rails removed from tracks and cost of renewing Iron per ton carried over the road.

Years.	Tonnage.	Number of bars removed from the tracks.	In proportion to tonnage.	Cost of renewing iron.	Cost per ton in cts.
1848	1,570,581	4,070	1 bar for 385	20,650 23	1·31
1849	1,429,564	3,352	" " 426	12,586 01	0·88
1850	1,748,680	4,219	" " 413	12,115 07	0·69
1851	2,145,182	5,982	" " 361	25,855 25	1·21
1852	2,122,171	7,327	" " 303	24,954 24	1·17
1853	2,076,197	8,082	" " 233	35,546 59	1·71
1854	2,582,563	11,112	" " 232	67,176 08	2·60

COAL TRANSPORTATION ON ASCENDING GRADES.

It is needless to observe that the cost and charges of the carriage of Coal on railways, is of vital importance to this region; and we have been at some pains lately to collect facts upon that subject. The following are the charges made upon Coal by railway from Pinegrove to Baltimore, to wit:

	Per Ton of 2240 lbs. CENTS.
Dauphin and Susquehanna Railroad, ascending grades of 33 feet per mile—Pinegrove to Penna. Railroad, 36 miles, ...	45
Penna. R. R., including wheel toll on light cars, 5 miles, ...	23
Cumberland Valley R. R. bridge at Harrisburg, 1 mile.	13
Northern Central R. R., ascending grades of 52 and 60 feet per mile, for haulage on 84 miles and use of cars, on 126 miles of main road, besides the laterals leading to the mines, and landage in the city of Baltimore,	144
Total charges from Pinegrove to Baltimore, 126 miles, . . .	225

The northern Central Railroad Company furnish the Coal cars for this business, and charge therefor ¼c per ton per mile for use of cars, and 1¼c per ton per mile for haulage and use of road. The Dauphin Company (who furnish no cars) charge 1¼c per ton per mile for haulage and use of road, up grade of 33 feet per mile.

These Companies, on grades of 33, 52, and 60 feet per mile, *ascending against the cones*, charge only 1½ cents per ton per mile for haulage, use of road and cars!

The Reading Railroad Company, on level and descending grades, charge 2 1-5 cents per ton per mile, or $2 for 92 miles from Mt. Carbon to Richmond.—*Pottsville Journal.*

SALE OF MR. MCGINNES' SHAFT COLLIERY, AT ST. CLAIR.

Mr. McGinnes has recently sold his Shaft and Slope Collieries, at St. Clair, to Messrs. Kirk & Banum, for $147,500!

This Shaft Colliery is one of the most celebrated that we have in the Coal region, not only on account of its being the first shaft sunk to the great Mammoth vein, and thereby proving the theory, so long entertained by Mr. McGinnes and others, of this vein underlying the entire Region, but also on account of the superior quality of Coal which it has produced.

It is sunk to the depth of nearly 450 feet into the deep basins, and the Coal brought up from thence is the most dense, hard and pure, that goes to market. We are told that in New York, it is preferred to all others.

From 800 to 1000 tons of Coal can be mined and prepared at those two Collieries per day, and the quantity of Coal which can be reached, by the shaft particularly, is almost inexhaustible.

We congratulate the Messrs. Kirk & Baum on their purchase, and take pleasure in saying that we believe them to be one of the most high-minded and honorable firms in our country. And on his retiring from those Collieries, we would take occasion to speak of Mr. McGinnes as one of the most determined men that we have among us. Perhaps no other man would have overcome the same difficulties that he did, in sinking his justly celebrated shaft; and we hope that the sale has amply remunerated him for his trouble and heavy expense.—*Ib.*

LEHIGH COAL REGION.

A writer in the *Mauch Chunk Gazette* discussing the relative circumstances of the Schuylkill, and Lehigh Regions, states the following facts:—

There is a vast field for improvement in both regions in the manner of mining and preparing coal. An arrangement well adapted to a certain vein will not answer as good a purpose in every case. On the Lehigh, generally, no coal is allowed to pass through the breakers which is already small enough—thus preventing waste; and the Chestnut Coal is screened separately in a smaller screen, with the addition of water when the coal is wet.

At Buck Mountain the prepared Coal is washed, which adds to its lustre, and appearance.

We give below notes of measurement of the different veins worked, showing their superiority, and the absence of fault, bone, slate and dirt:

Lehigh Summit, 50 ft. vein—38 ft. Coal, 12 ft. slate and bony coal. This measurement was made twelve years since, on the Summit, in open quarry, where the vein was worked by daylight, and coal separated, leaving the impurities behind.

No coal is mined now, by open work at the summit.

Middle Coal Field.—Buck Mountain (2d Basin). 4½ feet Bottom Coal; 8 feet dividing slate; 9 ft. Coal, and 6 ft. parting slate. Top vein not worked (2 feet thick).

Middle Coal Field.—Hazleton and Sugar Loaf Basin. Bottom Bench 4 ft; 1 foot slate; 7 ft. pure coal; 4 ft. parting slate, 6 ft. Coal.

Middle Coal Field.—Beaver Meadow and Spring Mountain. Bottom Bench, 4 to 4½ feet; 6 in. to 18 in. Slate; 6½ to 7 feet pure hard coal; 4 to 6 ft. parting slate; 6 ft. top Coal.

Nesquehoning Basin.—Southern Coal field. Here we have the 28 ft.; 5 ft.; 19 ft.; 39 ft.; "Pencil Vein," 12 ft.; "Vertical Vein," 19 feet; 50 ft. vein—two dips; 15 ft. vein, and a small vein not worked.

In addition to what Coal is shipped from the Southern and Middle Coal Fields, pre-eminently for all purposes for which Schuylkill Coal is applicable, we have Wyoming Coal mined by Wilkesbarre Coal Company, and Messrs. Paine & Co. from the Northern Coal Region, which, for steam generation in ocean Steamers and locomotives—in our opinion—cannot be excelled by any Schuylkill Coal shipped.

We have the "Black Creek," "Cross Creek," "Sandy Creek," "Pond Creek," and "Green Mountain" Basins, in the Middle Coal Field, unopened and unworked, equally as good as those now in operation. Openings are now being made in "Black Creek" basin.

CARBON IN ANTHRACITE.

Prof. Hare, in treating of carbon in connection with anthracite coal' says:—

"I ascertained that anthracite, when completely burned in oxygen gas produced *no diminution* of *volume*, the products being water and carbonic acid, united with hydrogen and oxygen in the proportion for forming water.

"The specific gravity of carbon, in the state of diamond, or in that of common charcoal, when examined in the pulverulent form, so that the result shall not be affected by the numerous cavities existing in it when in mass, is about 3.5.

"The specific gravity of anthracite does not exceed 1.6; that of a plumbago is 2.32; yet they are both much more *compact* than charcoal, and, in proportion to the space occupied by them in mass, obviously much heavier.

"Carbon, under some circumstances appears to have a transcendent affinity for oxygen. In its ordinary state it requires a temperature above redness, in order to exhibit this affinity—in other words, to burn. In proportion as it becomes denser and more pure, we find it more difficult to ignite."

Thus the susceptibility of ignition increases from the diamond to tinder in the following order: Diamond, plumbago, anthracite, coke, charcoal of hard wood, charcoal of soft wood. Tinder "in some forms, and when mixed with certain metals, iron or antimony for instance, takes fire *spontaneously* at ordinary temperatures."

COLUMBUS, O., September 29th, 1855.

WM. J. TENNEY, Esq., ED. *Mining Magazine.*

DEAR SIR:—I have just read the third number of volume V. of the *Mining Magazine*, the first time I have seen the work, and am much pleased with it It manifests the right spirit in warning the unwary in the speculating concerns, while it affords information to all on a great variety of subjects that have a bearing on mining, metallurgy, mines, geology and production, in all their relations to individual interests and political economy.

The subjects of mining and of applied geology and chemistry, as you may perhaps be aware, are of deep interest to me. I have been laboring for many years in them, and have endeavored to aid in developing the dormant mineral resources of our country. I can give much information in regard to mines, minerals, and mineral lands in Ohio and Kentucky, furnaces, the iron business, resources available now, and also in the future.

Pennsylvania, Ohio, Virginia, Kentucky, Maryland, are to be the great iron and coal producing states of the Union. Illinois, Indiana, Michigan, Iowa, and Missouri are abundantly supplied with coal and with much iron ore, but not like the first set mentioned.

Illinois is mostly underlaid with coal; Tennessee, Alabama, Arkansas, and Georgia, also contain coal in sufficient abundance; Massachusetts, Rhode Island, and North Carolina contain some coal; the Indian Territory west of Arkansas Missouri contains coal. In various parts of Nebraska and Kansas, and other and parts of our territory little investigated, it has been found. There is more coal known within the territory of the United States than in all the world besides. What does this indicate in the future? We have within our boundaries the elements of future wealth and production such as the world has not seen. Yours truly,

W. W. MATHER.

IRON AND ZINC.

The Iron Manufacture, Theoretically and Practically considered. By William Truran, C. E. Illustrated by 28 Plates. London: E. and N. Spon, 16, Bucklersbury.

The metallurgy of iron is a subject of considerable interest to the engineering profession; but hitherto we have been singularly deficient in treatises of a practical description, suitable alike for the iron manufacturer and the engineer. It is then, with much pleasure, that we notice the appearance of a work intended to supply the deficiency, written by an engineer, whose acquaintance with the subject has been obtained by a lengthy professional engagement with the largest ironmasters—Sir John Guest, and the Messrs. Crawshay. The manufacture of iron from the ore to the finished bar is ably treated, and, though there exists room for improvement, the work appears to be the most comprehensive hitherto published on this interesting branch of metallurgical science.

The author gives a general description of the ores used in the manufacture, dividing them into four great classes:—"The argillaceous ores of the coal formations, having clay, but sometimes silica as the chief alloy with the metal; the carbonaceous ores of the coal formation, distinguished for the large percentage of carbon in combination; the calcareous, principally from the limestone of the coal measures, having lime as their chief earthy admixture, and the silicious ores, having silica as the predominating earth." Analyses of several specimens from each of the ironmaking districts are appended. The coals used in smelting are similarly treated, and their composition illustrated by numerous analyses; as also are the fluxes used in the blast furnace. The second section is devoted to the preparatory operation of calcination; the furnaces used in this process, and the various modes of calcining, with the changes which the ores undergo, are fully described, and the importanee of subjecting ores to this process pointed out. The author deprecates the plan pursued in Scotland, and shows by calculations and analyses that, through the present unscientific system, the fuel wasted in that calcining process is amply sufficient for smelting the rich carbonaceous ores of that country.

The erection of blast furnaces, and the measures necessary to be taken to insure a successful "blowing in" are also detailed at length; but the sections of greatest interest to the metallurgist are those devoted to the "theory of the blast furnace," "practical smelting," and the "theory of production."—Under the latter head, particulars are given of furnaces worked with various volumes of blast, and differently burdened with solid materials, from which we learn, that in the production of gray irons the volumes of blast has to be

regulated, so that its ascent through the furnace shall occupy from seven to thirteen seconds of time, according to the burden of coal, and that a reduction of the volume permits of a reduction in the quantity of fuel—attended, however, with a reduced make of iron weekly—and vice versa, a larger volume of blast requiring a larger burden of fuel, in order to produce the same degree of Carbonization.

The several forms of furnace in use, and the effects produced by modifications, are fully elucidated. A section is occupied with the utilization of the gases, and the liquid slag of blast furnaces. The modes of collecting and applying the gaseous products are described; but the author is of opinion that it is not advisable to interfere with the operations of the furnace by collecting or in anywise controlling their escape. We have not space to follow the author in his reasoning on this point, but the general tenor of his views may be gathered from the following extract from the preface:—"And the remarks on the withdrawal of the gases from blast furnaces, and their subsequent construction, may lead to similar misapprehension, and the inference be drawn that the author deprecates innovation; but on this subject, which recently has been extensively agitated, and assumed to be practicable without creating any attendant disadvantages, it may be well to state, that the withdrawal of heat or gases from a furnace, either at a low level by natural draught, or from a high level by mechanical means, unless with a corresponding disturbance in the smelting operation, implies a superabundance and previous waste; the utilization of which, by the erection and adaptation of secondary apparatuses, may be profitable; but the legitimate mode of operating, by which a greater economy may be attained, is to adapt the quantity of fuel and form of the furnace to the requirements of the smelting process. If this be done, waste heat or other products capable of utilization, will not be evolved, and the advantages of perior economy be attained without having recourse to the large outlay of capital incidental to all plans, for economizing superfluous products."

The economy of heated air occupies a large section of the work: and, doubtless, this portion will be read with much interest by practical metallurgists, for the author arrives at the novel conclusion that the saving of fuel which follows on the employment of a heated blast, is not produced by the mere infusion of heat into the air, as is generally supposed, but results from the smaller volume of blast causing a less wasteful combustion in the upper regions of the furnace.

Passing over the sections on "the use of raw coal in blast furnaces," "blowing engines," "the refining of crude iron," and "the conversion of the cast into malleable iron," we extract the following pertinent remarks on the proper construction of furnaces:—"In a puddling or other furnace, a high temperature is required to be generated quickly, and maintained with the least consumption of coal. The arched and deflected form of the roof, by reverberating the heat back on the bottom, favors the attainment of these objects—an effect still further heightened by the reflective power of the vitreous glaze adhering to the brickwork. The escape of caloric otherwise than in contact with the metal under operation, it is desirable to prevent, by using in the construction of the interior lining as perfect a non-conductor and non-absorbent of heat as may be attainable for the purpose; the principle to be observed being the retention and concentration of the heat, that a maximum produce of iron may be attained with the consumption of a given weight of coal. Fire-brick is the only material obtainable in sufficient quantity, at a cheap rate; where a thickness of eight or nine inches is employed, the loss by conduction is not great; hence the furnaces are built and roofed with fire-brick, which generally lasts from three to four months in a workable condition. But in the substitution of iron water-boshes we see the opposite principle enforced: the temperature of the walls is lowered by the employment of a ready conductor and absorbent of heat, and as the current of air cannot absorb the caloric at the rate which the iron conducts it, more rapid absorption by the current of

water has been adopted. The principle of husbanding the heat evolved by the combustion of the fuel is altogether abandoned, and facilities are afforded for its escape. In all estimates, then, of other advantages derivable from water-boshes, the loss incurred by the escape of caloric in the water must be taken into consideration, as well as the loss of metal displayed by the inferior yields."

In another section of the work the author denies the existence of any waste heat in a properly constructed reverberatory furnace: "It should be distinctly understood that the heat escaping up the chimney is the motive power which creates the rapid draught, and that the caloric evolved by combustion of the fuel answers a double purpose: it heats the charge iron in the furnace to the required point, and by rarefaction imparts to the gaseous column high ascensional powers, without which the development of caloric proceeds too slowly for the rapid action demanded in all operations connected with the production of malleable iron bars: and farther, that where the area of fire-grate and area and elevation of chimney are correctly proportioned to each other, and to the mass of iron to be heated, and the operation is properly conducted, every unit of heat developed is absorbed either in a direct manner by the iron under treatment, or indirectly in creating the necessary draught: and any diminution of the ascensional power of the gaseous column, by the abstraction of caloric, reduces the drawing power of the chimney, and is followed by a corresponding reduction in the temperature of the body of the furnace, thereby prolonging the operation and augmenting the loss from oxydation. If we deprive the ascending column of the whole of its caloric, the draught is destroyed; if deprived of a portion only, the velocity of ascent and consequent intensity of the heat maintained is diminished in the same ratio. Hence, in a furnace correctly proportioned throughout, and properly managed, there is no waste heat, and any measures taken for the utilization of the heat of the ascending column, which do not provide for the loss of ascensional power, inevitably result in the efficiency of the fuel used being impaired to a great or lesser extent; when, however, through an erroneous mode of construction, or through improper management, the heat evolved is in excess of the quantity required for heating the charge and maintaining the draught, the surplus may be abstracted without injury to the operation; but while the utilization of the fuel thus charged in excess of the requirements of the case may be desirable, greater economy would be attained, and more science displayed, by the adaptation of the furnace to the fuel, and to the mass of iron under treatment."

The remarks on the legitimate modes of improving the quality of cast and malleable iron are worth perusing; as also are the sections on the power employed in the manufacture, the cost of manufacturing, &c.

The work is illustrated by numerous large plates, by Mr. Jobbins, the lithographer, showing the various furnaces, squeezers, and rolling machines employed in the manufacture, including several plates exhibiting the most approved modes of piling, heating, rolling, and finishing rail bars.—*London Civil Engineer and Architect's Journal.*

IRON AND STEEL.

The display of iron and steel manufactures greatly interested us, more especially the productions of Prussia. As at the World's Fair in London in 1851, so at the Great Exhibition in Paris, in 1855, M. Krupp, of Berlin, Prussia, made by far the finest display, surpassing both the French and English steel and iron makers. The Exhibition in London must have done good, for those who witnessed it have confessed that M. Krupp has improved upon his samples of fine steel there exhibited, and it will not be forgotten how these were admired and spoken of. His iron books, with leaves thin as paper, were described as the most wonderful achievement in the science of iron making. We must confess that it was impossible to ascertain whether France, Germany, or England occupied the first place for iron products; so far, however, as it relates to

commercial utility—cheapness of product—England surpasses all the others, but the products of each—taking a general view of them—were nearly alike, massive and beautiful. There were huge iron rails 60 feet long, and iron girders of equal length. There were iron plates for the new French gun-boats, 30 feet long, 6 feet wide, and 4 inches thick, made by M. Cave & Co., and intended to knock down with impunity the granite walls of fort and citadel. There were also displayed sheets of iron 30 feet long, and as many wide, and M. Petin & Co., desplayed steel tires for locomotive wheels 15 feet indiameter. The wheel adopted on all the French lines of railroads is composed of a corrugated steel disk bound to a steel tire, and a solid hub pierced for the axle. These are stated to be cheaper and stronger than any other kind—the cheapness having reference to durability. One large wheel 18 feet in diameter, forged wholly of iron—nave, felly, and spokes—exhibited by a M. Gouin, attracted much attention for its huge proportions, and the massive machinery required to forge it. We were not prepared to see such masses of iron forged into wheels, beams, and plates, but the Titan power of steam is equal to the task. Those on exhibition were worth a voyage across the Atlantic to behold. —*Scientific American.*

NEW PATENTS.

Improvement in Furnaces for Treating Zinc Ores: Samuel T. Jones, city of New York.

Claim.—"The double use of the chimney by combining the said chimney governed by a damper or register with the furnace and collecting apparatus and interposed between the two, whereby, the iron contained in the ore can be worked after the zinc has been worked and collected."

Improvement in Alloys for Journal Boxes: Joseph Garratt, Sen., Indianapolis, Indiana.

Claim.—"The production of an alloy of a bluish gray color, which, while it has unsurpassable anti-friction qualities, has also sufficient tenacity to allow of journal boxes being formed of it that do not require the protection of outer casings of a harder metal, the said alloy being composed of zinc, copper, and antimony in about the following proportions, viz: seventeen parts zinc, one part copper, and one part and a half of antimony, or any other mixture substantially the same, and which will produce the same effect."

Improvement in Making Zinc White: Samuel T. Jones, city of New York.

Claim.—"The manufacture of white oxide of zinc from ores of zinc or franklinite, by means of a furnace having perforated grate bars and an air chamber underneath them, in which hot or cold blasts of air are forced to unite with the ignited mass of fuel in a diffused state, by passing through the perforations of the grate bars to liberate the zinc in the form of vapor, in manner of construction and mode of operation as set forth."

Improvement in Sheet Metal Folding Machines: Orson W. Stow, Plantsville, Connecticut.

Claim.—"Effecting the simultaneous action of the two folding bars, by so connecting or driving them, that, upon operation being given to the one folding bar, the other folding bar is set in corresponding action or motion thereby, whereby the folding plate is relieved from unequal and varying strain or pressure on its one side or face, the two 'folding bars' are necessitated to act in unison, and the one operative lever serves to set both 'folding bars' in motion."

THE

MINING MAGAZINE:

DEVOTED TO

Mines, Mining Operations, Metallurgy, &c., &c.

VOL. V.—DECEMBER, 1855.—No. VI.

ART. VII.—THE IRON MANUFACTURE OF GREAT BRITAIN—THEORETICALLY AND PRACTICALLY CONSIDERED.*—By WM. TRURAN, C. E. No. 2.†

MATERIALS USED IN THE MANUFACTURE.

THE South Wales field contains several valuable seams of carbonaceous ore which are wrought to a limited extent only in comparison with the other ores. From not sufficiently attending to the peculiar composition of these ores, the crude iron obtained, when they form the entire burden of ore on the furnace, is generally of an inferior description, and incapable of being converted into bars without great waste. Hence the general dislike of these ores in the Welsh district.

* The Iron Manufacture of Great Britain Theoretically and Practically considered, including descriptive details of the ores, fuels, and fluxes employed; the preliminary operation of calcination; the blast, refining, puddling and balling furnaces, engines and machinery; and the various processes in union; statements of the quantity of material; period of time, and amount of power consumed in the successive stages; cost of raising minerals: and manufacturing crude and finished iron; and analytical researches into the economy of fuel in blast furnaces. By Wm. Truran, C. E., illustrated by twenty-three plates of furnaces and machinery in operation. London, 1855.

This work is in course of republication entire in the Mining Magazine, with the plates executed in the best style of lithographic art, and accompanied with American notes. Copyright secured.

The following is the preface and table of contents which were omitted with No. 1, for want of space—

Preface.—Among the manufactures of Great Britain, that of iron, though early conducted on a small scale, and known to the nations of antiquity, has recently risen to a magnitude which entitles it to rank as the most important, both in the intrinsic value of the products, and the direct bearing they have on the progress of civilization and commerce. Iron is a metal comparatively unknown in uncivilized districts, and it is worthy of remark that the production and consumption of this metal in proportion to the population is highest in nations excelling in commerce and the mechanic arts, declining as we descend the scale of civilization, until arriving at the lowest degree of intellect displayed by the human race (the islanders of the southern and eastern ocean), it is discovered wanting. The ores of the iron are extensively disseminated through the terreous portion of the globe, but their conversion in quantity into metallic iron is limited to a few of the more advanced European nations, and the Anglo-Saxon population of the American States. The presence of apparently inexhaustible supplies of ores of varied characters and qualities, obtained with the greatest facility and yielding irons of the finest description, interstratified

† Continued from page 425.—Vol. V.

At the Beaufort works, three seams of carbonaceous ore, measuring in the aggregate 3 feet 6 inches in thickness, and yielding 34 per cent. of metal have been partially wrought for the furnaces. A seam at the Blaina workings averages 38 per cent. of metal, but at the Nanty-glo workings in the same valley, the yield is only 13 per cent.

with and immediately contiguous to vast deposits of mineral fuel peculiarly adapted for their advantageous reduction, has resulted in an extraordinary development of the manufacture in Great Britain within the last few years, consequent on the large demand for cast and malleable iron for railroad, engineering, and navigation purposes. At the present day, the annual production of three of the principal districts of the United Kingdom, viz.. South Wales, South Staffordshire, and Scotland, considerably exceeds the collective production of all other nations. The importance of this branch of metallurgical industry to the commercial prosperity of the kingdom may be inferred from the circumstance that, while the home consumption in foundries and manufactories absorbs the one-half of the production, the quantity exported is scarcely inferior to the gross produce of all other nations, a fact which shows a high state of mechanical science and the attainment of a degree of perfection far beyond that common abroad. The production of crude iron during the past year (1854) exceeded 3½ millions tons; and the production of malleable iron amounted to nearly 2 millions tons; value in the manufactured form at current prices 25 millions; the number of operatives employed in the manufacture including those engaged in the allied operations of quarrying and extracting the minerals 238,000; and in giving motion to the various machines, and exciting combustion in the furnaces there were 2120 steam engines of an aggregate power of 242,000 horses.

On a manufacture of such magnitude and importance there exists no published treatise beyond the one entitled "Mushet's papers on Iron and Steel," originally published more than half-a-century ago, when the annual production scarcely reached 100,000 tons, and confined to a consideration of the then known facts relating to the production of crude iron. In later years papers on subjects connected with the manufacture have appeared in various journals, but their scientific value is considerably lessened through either their antique bearing, or the theoretical views and evident bias of the writers in favor of particular processes and patented inventions. This paucity of reliable information on the principles involved in the various processes of the manufacture, has arisen principally from the disinclination to communicate their experience so generally manifested by parties practically acquainted with the subject, but partly from the inability of those otherwise competent and disposed to undertake the task to illustrate their work with the requisite drawings. In submitting the following pages, the author deems an apology unnecessary—the general want of a comprehensive work on the subject is too well known to require comment; the facts and observations put forward, are founded on the results of nearly seventeen years practice, and comprise, in addition to descriptive details of the furnaces, and machines employed, and the various operations incidental to the manufacture of iron in a large way, theoretical analyses of the causes contributing to the economical production of the various qualities of crude and malleable iron from different descriptions of ores under dissimilar modes of treatment—the object being the dissemination of correct information on the points of greatest importance.

The remarks on the hot-blast system and the conclusions drawn of the effect, so commonly ascribed to the application of this invention being due to causes other than the mere heating, and may be attained without its intervention, though given after mature consideration, and an attentive examination of the results produced on different furnaces, are at variance with received opin-

In the western part of this field, the Crom Avon ore yields 22, and the Oakwood 21 per cent. At the Yniscedwyn workings this ore yields 36 per cent. From these figures it will be seen that the variation in the yield of the carbonaceous ores of this field is greater than in the Scotch; and we may remark that the development of the seams is more local and irregular.

ions on the subject, and may lead the reader to the inference that their purpose is other than to convey correct ideas on a very important department of the manufacture. In arriving, however, at just conclusions it will be remembered that while the surprising economy of the hot blast in certain districts previously using very large quantities of coal are freely admitted, the reason given by writers generally of its superiority, "that the heated blast is better fitted for supporting combustion," is altogether untenable. It does not account for the heat yielded by the combustion of a given quantity of coal in the stove grates being so much superior to that developed by a similar quantity consumed in the furnace; it does not account for the inability of the heated blast to economize fuel in heavily burdened charcoal furnaces; it is insufficient to account for the variation in the results obtained with different coals in similarly formed furnaces, and the dissimilar effects observed with the same fuel in differently shaped furnaces; neither does it explain the reason why the beneficial effects of heated air on combustion should be confined to blast furnaces, nor for the cold blast being for a limited period superior to the hot on hot blast furnaces.

And the remarks on the withdrawal of the gases from blast furnaces and their subsequent combustion may lead to similar misapprehension, and the inference be drawn that the author deprecates innovation; but on this subject, which recently has been extensively agitated and assumed to be practicable without creating any attendant disadvantages, it may be well to state, that, the withdrawal of heat or gases from a furnace, either at a low level by natural draught, or from a high level by mechanical means, unless with a corresponding disturbance in the smelting operation, implies a superabundance and previous waste; the utilization of which, by the erection and adaptation of secondary apparatuses, may be profitable, but the legitimate mode of operating, by which a greater economy may be obtained, is to adapt the quantity of fuel and form of the furnace to the requirements of the smelting process. If this be done, waste heat or other products capable of utilization will not be evolved, and the advantages of superior economy may be attained without having recourse to the large outlay of capital incidental to all plans for economizing superfluous products.

On other points also, in which the views taken differ from the opinions generally advanced by writers on iron, the author has been guided by deductions drawn from practical observation, and however novel may appear the conclusions, believes they are substantially correct, and in the elimination of the principles regulating the economy of the several processes entitled to greater consideration than mere speculative theories unsupported by practice.

The Historical portion of the subject has been omitted. The author's acknowledgments are due to Mr. P. L. Simmonds, and other gentlemen, for much valuable matter bearing on this portion; its able treatment by Mr. Scrivenor in his "History of the Iron Trade;" and the generally little interest taken in it by many manufacturers and parties practically engaged, has been considered a sufficient reason for confining the work to its present limits.

INDEX TO CONTENTS.

The composition of a number of seams, principally those wrought by the Dowlais Company, is seen in the accompanying table of analysis.

ANALYSIS OF CARBONACEOUS ORES FROM THE SOUTH WALES COAL FIELD.

	1	2	3	4	5	6
Carbonate of Iron......	58.9	81.6	92.8	29.0	79.8	80.
Carbonaceous matter...	31.3	11.4	5.3	23.0	10.1	9.5
Carbonate of Lime.....	.7			.2	.6	.2
Silica................	3.5	2.9	.7	32.4	5.1	8.2
Alumina..............	3.9	1.7	1.1	14.6	2.4	1.
Bisulphuret of Iron....	1.				.3	
Moisture and loss......	.7	2.4	.1	.8	1.2	1.1
Manganese............	trace			trace		
Yield of Metallic Iron...	28.3	39.3	44.7	14.0	38.4	38.5

ceous ores; Northamptonshire siliceous ores; composition of the oxides and sulphurets of Iron. *Blast Furnace Coals:*—analyses of Pontypool, Dowlais, Hirwain, and anthracite South Wales coals, and Newcastle, Yorkshire, Derbyshire, and Scotch coals. *Fluxes:* analyses of limestone and chalk.

SECTION 2. *Calcination of Ores.*—Modes, kiln and open air; comparative cost; effects on the ore; loss of weight; treatment of hematites. *Preparation of fuel:*—coking. *Flux:*—calcination.

SECTION 3. *Erection of the Blast Furnace and appendages.*—Details of dimensions and measures to be observed in their erection; drying; tuyere pipes and connections. *Apparatus for Lifting the Materials:* inclined plane; water balance; vertical lift; pneumatic lift. *Heating Apparatus:* description, and proportion to volume of blast.

SECTION 4. *The Blowing-in of Blast Furnaces:*—Preliminary arrangements; size of pipes; injurious effects of forcing; examples of burdens. *Theory of the Blast Furnace:*—Composition and transformations of the ascending and descending columns; analyses of gases. *Composition of the liquid products* of the operation; analyses of cinders, crude iron; conclusions drawn from ditto.

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CALCAREOUS ORES.

The Calcareous iron ores, or the sparry carbonates of iron, are principally obtained from workings in the carboniferous or mountain limestone. In Dean Forest large quantities have been mined and smelted in the adjacent works; and of late years considerable quantities have been carried away, and smelted along with the argillaceous ores in the iron works of Glamorganshire.

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SECTION 20. *Cost of raising minerals* and producing crude and finished

Large deposits of these ores are also wrought in Lancashire and Cumberland, from whence they are transported, principally to Wales, but to a minor extent to Staffordshire, Yorkshire, and Scotland. The carboniferous limestones of Derbyshire, Somersetshire, and South Wales, contain deposits, and limited quantities are occasionally wrought; but it is from the Dean Forest, Lancashire, and Cumberland Mines, that the present supply is chiefly obtained.

By analysis of a compound sample, we find that the average

iron at Merthyr Tydfil; ores in Dean Forest; crude iron in Scotland. List o furnaces in Great Britain, their capacity and produce of crude iron for 1854.

ILLUSTRATIONS.

Plate 1. Elevation, Plan and Section of Calcining Kiln—Dowlais Works.

Plate 2. Sectional Elevation of large Blast Furnace—Dowlais Works.

Plate 3. Sectional Plans of large Blast Furnace. Hearth Bricks—Langloan Works. Ditto—Dowlais Works.

Plate 4. Sectional Elevation of Cupola. Furnace—Sirhowy Works. Sections showing Modes of Collecting Furnace Gases.

Plate 5. Details of Blast Furnace, including tuyere pipes at the Dowlais, Plymouth, Ebbw Vale, and Aberdare Works. Water Tuyeres, &c.

Plate 6. Sectional Elevations of Hot Blast Stoves at the Dowlais, Penydarran, Ebbw Vale, and Ystalyfera Works.

Plate 7. Sections of 25 Blast Furnaces, including Furnaces at the Ebbw Vale, Sirhowy, Tredegar, Rhymney, Dowlais, Plymouth, Aberamman, Abernant, Pentyrch, Ystalyfera, Corbyn's Hall, Muirkirk, Kinniel, Dandyvan, Alfreton, and other Works.

Plate 8. Sectional Elevations and Plan of Double Refinery—Dowlais Works.

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Plate 12. Puddling Roll Train—Cyfarthfa Works.

Plate 13. Balling Furnace—Cyfarthfa Works.

Plate 14. Cropping Shears—Dowlais Works, including Puddling, Bundle Iron, Cold Iron, and Heavy Scrap.

Plate 15. Sawing Machinery—Dowlais Works.

Plate 16. Double Rail Straightening Machines—Cyfarthfa Works. Ditto ditto—Dowlais Works.

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Plate 18. Slitting Mill, Dowlais Works. Sheet Mill, Forest Works.

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Plate 20. Illustrations of Rolling one quarter size,—Grooves in blooming, roughing and finishing rolls of Barlow's Colossal Bridge Rail; Waterford and Limerick double head ditto; American Bridge ditto; ditto Colossal Flanch ditto.

Plate 21. Illustrations of Rolling, one third size.—Grooves in roughing and finishing rolls of German Flanch Rail.—Great Western Bridge ditto. Dublin and Drogheda ∩ section.—Glamorganshire Canal Companies Tramplate.

Plate 22. Grooves in roughing, oval and finishing rolls of 8 inch Guide Train.

Plate 23. Illustrations of Rolling. Form and draught of Grooves in merchant bar and other roughing rolls.

composition of the calcareous ores of Dean Forest is nearly as follows:

Peroxide of Iron	54.0
Carbonate of Lime	35.0
Clay	7.0
Moisture	4.0

Metallic Iron 37.5 per cent.

This, to persons who use these ores, in mixture with others, will probably seem a low yield, but from numerous assays as well as experimental trials in the blast furnace, we find that the mass of these ores will not exceed 38 per cent. Where the specimens examined have been selected for their apparent richness, we have found the produce higher, as in the following specimen from the same district.

Peroxide of Iron	67.0
Carbonate of Lime	24.3
Clay	6.5
Moisture	2.2

Metallic Iron 46.5 per cent.

In contrast to the preceding analysis, we annex the produce of a calcareous ore offered by the vendors as containing a large per-centage of iron.

Peroxide of Iron	10.1
Carbonate of Lime	52.5
Clay	34.4
Moisture	3.0

Metallic Iron 7 per cent.

The red hematites of Lancashire and Cumberland are the richest ores of iron that we possess in this country. And although their extensive use in the blast furnace with coke or raw coal, dates but a few years back, they are now largely mined; and are advantageously smelted along with the leaner argillaceous ores, where the resulting crude iron is intended for conversion into malleable bars. Probably the time is not distant when these ores will be largely smelted without the admixture of the leaner varieties.

By analysis we find that the average produce of the Ulverstone, Lancashire ore, to be nearly as follows:

Peroxide of Iron	70.6
Silica	27.9
Alumina	.5
Lime	.3
Sulphur	.4
Magnesia	.2
Phosphoric acid	.1

Metallic Iron 49 per cent.

This we consider to be very near the average yield of the red hematite. Varieties of this ore will yield a greater produce of metal, but taking the average of a cargo as it comes from the mines, the produce will not reach 50 per cent.

The analysis of a selected specimen from the same locality, Ulverstone, gave the following results:

Peroxide of Iron	81.6
Silica	10.2
Alumina	5.0
Moisture	3.0
Lime	.2

Metallic Iron 56.6 per cent.

But the analysis of a third sample, taken promiscuously from different parts of a cargo, gave a lower produce than either of the foregoing, the quantities being:

Peroxide of Iron	60.4
Silica	17.2
Alumina	6.8
Carbonate of Lime	7.9
Moisture	7.7

Metallic Iron 41.8 per cent.

Limited quantities of hematite have been wrought in the Somersetshire carboniferous limestone. The following is an analysis, by Mitchell, of a very rich specimen from near Bristol:

Peroxide of Iron	85.000
Alumina	6.250
Silica	3.304
Lime	1.087
Magnesia	1.458
Oxide of Manganese	1.601
Sulphur	.210
Phosphoric acid	.457
Potash, Soda, loss	.633

Metallic Iron 58.9 per cent.

Cornwall and Devonshire produce considerable quantities of hematite; but the average produce of metal of the ores, from these counties, is not equal to that from the Lancashire and Cumberland ores.

By analysis, a piece of the hematite from the Duchy mines, Cornwall, yielded:

Peroxide of Iron	57.00
Silica	23.40
Alumina	7.38
Lime	7.29
Magnesia	4.22
Phosphoric acid	.85
Manganese	.86

Metallic Iron 39.5 per cent.

This we consider as above the average produce of the Cornish ores, which do not, in the mass, yield more than 36 per cent, for ordinarily clean ores.

Another specimen of Cornish ore, the richest in metal that we have operated on, when analyzed, gave the following results:

Peroxide of Iron	86.62
Silica	1.85
Manganese	.86
Water, loss and Phosphoric acid	12.17

Metallic Iron 60 per cent.

The clay slate formation of North Wales yields a number of ores, of less or greater value in iron making. The analysis of a specimen from Carnarvonshire gave the following results:

Peroxide of Iron	79.5
Water	7.0
Silica	8.2
Alumina	4.5
Lime	.3
Phosphoric acid	.1
Magnesia	trace

Metallic Iron 55 per cent.

The analysis of a selected specimen of ore from Merionethshire, yielded:

Peroxide of Iron	71.6
Clay	18.6
Water	6.8
Carbonaceous matter	3.0

Metallic Iron 49.6 per cent.

SILICEOUS ORES.

The use of Siliceous ores in quantity in the blast furnace with coal or coke, as fuel, dates from the discovery of extensive deposits of these ores in Northamptonshire and Yorkshire. The comparatively low cost at which they are mined, and the large percentage of iron which the best varieties yield, when carefully selected, will probably operate as an inducement for their more extended use in the manufacture of particular qualities of crude iron. Hitherto a prejudice has existed against the use of these ores otherwise than in mixture, from certain peculiarities displayed by the finished iron, but when their properties are better understood, their reduction in suitably constructed furnaces, with raw coal as fuel, will result in the production of crude iron, which may be afterwards manufactured into bars of a quality little inferior to those now obtained from the argillaceous ores.

The general composition of the Northampton ore is shown in

the following analysis by Bernays, of Derby, of the ores mined by the Duston Company:

	No. 1.	2.	3.
Peroxide of Iron....	67.20	58.40	44.0
Sand and Silica.....	11.00	21.60	34.0
Alumina..........	11.00	5.20	4.52
Water............	10.40	12.00	14.08
Unestimated matter.	.40	2.80	3.40
Yield of Metallic Iron...	47.	48.8	30.8

On analyzing portion of a sample obtained at different periods, during the delivery of a large contract, we found the average composition of the ores from the Northamptonshire District, to be nearly as follows:

Peroxide of Iron...............	54.6
Carbonate of Lime.............	19.3
" " Magnesia..........	4.0
Protoxide of Manganese.........	.5
Silica.......................	10.3
Alumina.....................	2.1
Water.......................	9.2

Metallic Iron 37.8 per cent.

Composition of the oxides and sulphurets of iron. Decimally the protoxide of iron consists of

Iron.........................	7723
Oxygen.......................	2277
The Magnetic oxide of	
Iron.........................	7179
Oxygen.......................	2821
The Peroxide of	
Iron.........................	6934
Oxygen.......................	3066
The Brown hydrated-oxide of	
Iron.........................	5915
Oxygen.......................	2615
Water........................	1470
The Carbonate of	
Iron.........................	4747
Oxygen.......................	1400
Carbon.......................	1053
Oxygen.......................	2800
The White Sulphuret of	
Iron.........................	4507
Sulphur......................	5335
Manganese....................	0058
The Yellow Sulphuret of	
Iron.........................	4730
Sulphur......................	5270

NOTE.—We have observed statements implying a rapid exhaustion of the iron making materials of the United Kingdom, and predicting that at no distant day, the furnaces of this country will be worked with the iron ores of the United States of America. We believe that in two of the smallest fields, Shropshire and Staffordshire, a large portion of the ores have been wrought,

BLAST FURNACE COALS.

In the manufacture of iron, the fossil fuel with which this country so freely abounds, is now exclusively used in all the various operations. Charcoal, which was once considered as the only fuel with which good merchantable iron could be manufactured, is now, from its high price and scarcity, confined to the conversion of malleable iron into plates and bars for tinning, and other purposes, where a very superior quality of iron is desired.

The South Wales coal basin is at this date the one from which the largest quantity of coal is being extracted, and used in the manufacture. Its great area, and the superior quality of the coals over all other formations in this country, doubtless, will enable it to maintain this lead for several centuries to come. It possesses coals of nearly every quality with which we are acquainted. On the eastern side, the seams are generally of a bituminous character; farther west, following the north outcrop, we find them at the Rhymney. Dowlais and Penydarran works of a semi-bituminous; and proceeding yet farther to the Neath Valley, on the western crop, we find the different seams changed into anthracite. In the central portions of the basin seams of a highly bituminous description, forming the upper series, are worked and used to a limited extent in smelting.

The distinguishing character of the Welsh coals over others, is the large amount of carbon which they contain. In smelting, and in the other operations of the manufacture, the useful effects of coals of the bituminous, and semi-bituminous classes, is in proportion to the richness in carbon. The Welsh blast furnace coals yield from 80 to 92 per cent. of carbon.

On the north-eastern side of the basin near Pontypool, where the coal is of a bituminous kind, and is coked for use in the blast furnace, an analysis gave the following results:

Carbon	80.5
Hydrogen	5.7
Oxygen	5.2
Nitrogen	1.2
Sulphur	.9
Earthy matter	6.5

At the Dowlais Works, where the coal is used in a raw state, the composition of the upper four-feet seam, considered the best

but there exists in the other fields a sufficiency of ores and fuel for a manufacture on a greatly extended scale for some thousands of years to come. The Welsh field alone has an area of more than 1000 miles; estimating that only one half of the ores are extracted, it is capable of yielding 40,000 tons per acre. Now the present annual consumpt of ores of all descriptions, is about twelve millions, equal to the produce of 300 acres of the Welsh field. Hence, at this consumpt, this field contains a sufficiency of ores for supplying the iron works of this country for 2000 years. When the other sources of supply are considered, the improbability of importing ores is very apparent.

for smelting of the various seams in the Dowlais mountain, is nearly as follows:

Carbon	87.0
Hydrogen	4.9
Oxygen	3.8
Nitrogen	1.7
Sulphur	.2
Earthy matter	2.4

Another seam, wrought by the same company, but which is not considered a good furnace coal, yielded

Carbon	90.0
Hydrogen	3.8
Oxygen	3.2
Nitrogen	.8
Sulphur	1.3
Earthy matter	1.4

The thick coal, wrought for the Hirwain furnaces, directly on the edge of the great anthracite formation, yielded as follows:

Carbon	87.2
Hydrogen	4.0
Nitrogen	1.5
Sulphur	.7
Oxygen	2.0
Earthy matter	4.4

The anthracite district on the western crop of the basin, produces coals of a superior description for smelting. By analysis, a specimen from the Swansea valley, intended as a sample of the coals used in the Yniscedwyn and Ystalyfera works, the two largest in the anthracite district, yielded the following results:

Carbon	91.5
Hydrogen	3.5
Oxygen	2.6
Sulphur	.6
Nitrogen	.3
Earthy matter	.5

The Staffordshire coal field, though inferior in extent to the South Wales, contains a number of seams with which iron of an excellent quality has been manufactured. The ten-yard seam, the thickest coal seam in this country, is especially adapted for its fitness for smelting. Their composition and qualities for the blast furnace differ but slightly from that of the bituminous coals on the eastern side of the Welsh basin. In some localities the carbon is less abundant, while in others it is quite equal to the Pontypool coals.

The bituminous coals used in the minor iron making districts of Dean Forest, Shropshire, Derbyshire, North Wales, Yorkshire, and Northumberland, are of a weaker character than the Welsh,

and contain considerably less carbon. The Newcastle coals contain by analysis

Carbon	78.0
Hydrogen	7.8
Nitrogen	1.6
Oxygen	2.8
Sulphur	1.6
Earthy matter	8.2

The best of the furnace coals wrought in Yorkshire yielded by analysis:

Carbon	78.8
Hydrogen	5.5
Nitrogen	2.0
Oxygen	6.4
Sulphur	2.1
Earthy matter	5.2

According to the Analysis of Messrs. Bunsen and Playfair, the Alfreton, Derbyshire furnace coal is composed of

Carbon	74.98
Hydrogen	4.73
Oxygen	10.01
Nitrogen	.18
Water	7.49
Silica	2.61
Potash	.07

The coals obtained from the Scotch fields for iron-making are also poor in carbon compared with the Welsh coals. When coked, they yield from 40 to 50 per cent. of weak cokes. At the present day the Scotch coals are, with one or two exceptions, used in the raw state in the blast furnace. By analysis we find the composition of the coals used at the Gartsherry furnaces to be as under:

Carbon	76.5
Hydrogen	5.0
Oxygen	9.1
Sulphur	.8
Nitrogen	1.2
Earthy matter	6.4

FLUXES.

Limestone is the almost universal flux used in the blast furnace. At some furnaces in the neighborhood of Newcastle, chalk is occasionally employed, but this, we believe, is the only locality where it is used in iron-making. The occurrence of limestone in conjunction with the other materials requisite in the manufacture—iron ore and coal—and the generally cheap rate at which it is obtained, are advantages which no other materials hitherto discovered possess to a like extent.

The limestone used in the Welsh works lies but a short distance below the seams of coal and ore. On the North outcrop it is of immense thickness, and apparently inexhaustible. When analyzed, the blue mountain limestone, upper beds of the formation, as used at the Dowlais furnaces yielded

Carbonate of Lime	96.0
Alumina	1.5
Silica	2.5

Lime 55 per cent.

In Staffordshire, Dean Forest, and the other iron-making districts of England, the limestone formation is usually much thinner, and the quality of the stone, judging from its yield of lime, which constitutes its excellence in iron making, is also inferior to the stone from the quarries around Merthyr Tydvil. In some specimens from Dean Forest, the quantity of lime is as low as 36 per cent., while the proportion of silica and clay rises as high as 20 per cent. of the whole. Such stones, however, are not used in the furnace, when others containing a large per-centage of lime can be obtained at a remunerative price.

The limestone used in the Alfreton furnaces yielded in the hands of M. Bunsen,

Lime	54.4
Carbonic acid	42.9
Magnesia	.6
Alumina	.8
Moisture and loss	1.3

The limestone used at the Scotch blast furnaces are extremely varied in their character and general composition. The purest specimen that we have examined contained,

Lime	54.0
Carbonic acid	42.7
Alumina	.5
Silica	.7
Iron	1.0
Moisture	1.1

The composition of the chalk used as a flux, in the Newcastle furnaces is nearly as follows:

Carbonic acid and water	45.0
Silex	1.0
Lime	54.0

Containing so large a proportion of lime, chalk is well fitted to act as a flux in smelting, but its occurrence at considerable distance from the great iron-making districts, renders it a costly material in comparison with local limestone.

SECTION II.—CALCINATION OF IRON ORES.

Experience has demonstrated that the various ores of iron used in the manufacture, work better in the blast furnace if previously calcined. This preliminary operation is performed in various ways; the plan generally followed in Wales is that of calcination in kilns. These vary greatly in their dimensions; the most satisfactory results are obtained with kilns of the kind delineated in Plate 1. It will be seen by referring to that plate, that the floor is composed of cast iron plates, 2 inches thick. The interior measures 20 feet in length, 9 feet in width at top, and 18 feet deep. It is built of masonry, and lined inside with firebricks, 14 inches long. In front there are two arches, with openings on a level with the floor through which the calcined ore is drawn, and filled into barrows for the furnace. Above these openings, within the semicircle of the arch, it is usual to leave four or five orifices, 6 to 8 inches square, for regulating the draught. Around the upper edge of the kiln there is placed a cast iron ring, from 12 to 15 inches wide, with a flanch about 6 inches high on the inner edge, to protect the brickwork from injury during the filling of the raw ore.

At some works the kilns are of a circular form in the plan of the interior; at others they are built square, and sharp in the angles, but it is to those of the form represented in the plate that the preference is generally accorded. Square kilns, or those having sharp angles in their interior are objectionable, inasmuch as the combustion is slower in the angles than in the centre. If the heat is regulated to properly calcine the centre of the mass, the pieces lying in the angles will scarcely have altered from their raw state.

The operation of calcining in kilns may be described thus:—Two or three small coal fires having been lit on the floor, raw ore is placed over and round until the whole of the floor is covered with ore at a dull red heat, when a fresh layer of ore to a depth of 8 or 9 inches is added, along with about five per cent. by weight of coal. As soon as the upper stratum has reached the red heat, another is added. The addition of fresh layers of raw ore and coal is repeated as fast as the previous layers have been heated to the necessary degree.

In consequence of the small quantity of coal used in the process, by the time that the kiln is filled with successive layers of raw ore, the lower portions, which were first ignited, are comparatively cold and fit for drawing.

In Scotland and in several other districts the calcination is generally effected in the open air. A space is roughly levelled, on which a stratum of coal a few inches thick is laid. On the coal a layer of raw ore, 10 or 12 inches in thickness, is placed, and a small quantity of coal thrown over the ore. Additional layers of ore and coal are added until the heap reaches to a height of 4 or

5 feet. Fire is now applied to the bottom stratum of coals, and in a few hours the entire mass will be ignited. The operation, from the time of firing till the heap has cooled sufficiently for drawing, will occupy from 6 to 12 days, depending on the nature of the ore, quantity and quality of fuel, and size of heap.

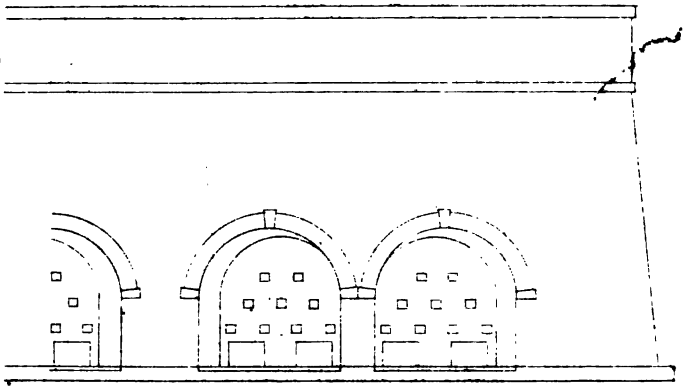
Calcination in the open air is also carried on to a limited extent in some Welsh works. The operation being there known as burning in "clamps," in contradistinction to burning in kilns. The method of building and firing these clamps is nearly the same as that pursued in the Scotch works.

Of the merits of the respective systems there can be but one opinion. If we admit that calcination is a necessary operation on the ore before it enters the blast furnace—and there are few practical men who question its utility—we must concede to the kiln the merit of performing the operation more effectually than can be done in the open air. Under the clamping system, if the operation has been otherwise successfully performed, the outside stones are only partially torrefied; but the greatest defect of the system lies in the difficulty experienced in maintaining an equable temperature throughout the heap. Open and exposed on all sides to the weather, wind draughts are created, and the adjacent stones not unfrequently melted into a hard refractory mass. When such a result threatens any portion of the heap, attempts are made to check the draught in that quarter, but if successful the changing of the wind probably brings on the evil in other places. Again, should heavy rains occur during the burning, from the great surface of stones exposed to the atmosphere, a considerable portion of the heap will be found only very slightly affected by the operation. When we look at the frequency of atmospheric changes in this country, and the extent to which the calcination of ore conducted on the open air plan is impaired by them, it is a matter of surprise that such an inefficient plan should be in use at many old established works in Staffordshire and other districts.

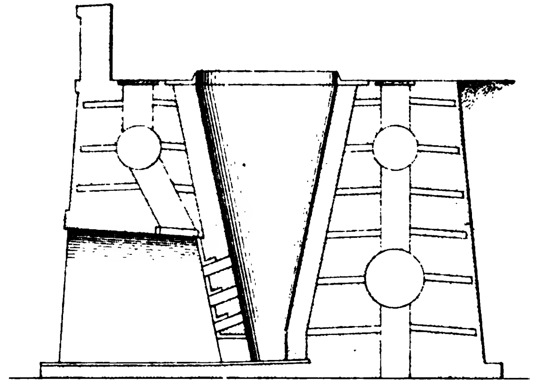
We do not know of any advantage which the open air system possesses over kilns beyond the lesser outlay of capital. But this saving in the outlay of capital is very small in comparison with the advantages offered by kilns. The first cost of the kiln delineated in the plate, will not, in most iron making districts, exceed £160. Its capacity is equal to 70 tons of argillaceous ore; with ordinary attention it will calcine 146 tons weekly. Hence the outlay of capital in the erection of kilns entails a fixed cost of one farthing on each ton of ore calcined.

But if the open air system saves this small outlay of capital, it is, in the matter of labor and fuel, by far the most expensive of the two systems.

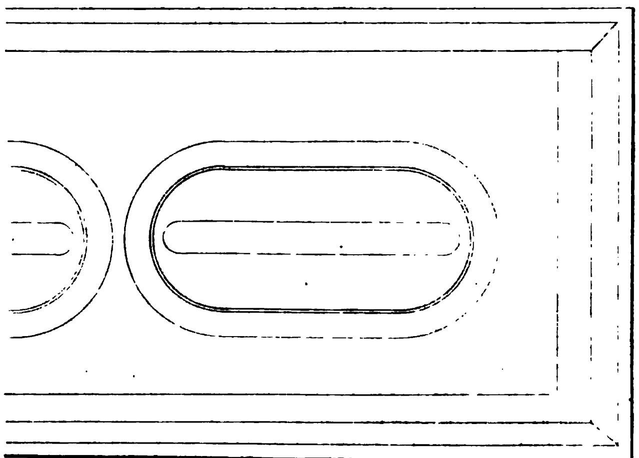
With kilns the cost of the labor of tipping and filling the ore and coal is barely one penny per ton. Small coal suffices for the operation, and the quantity used, if of an average quality, is one



FRONT ELEVATION



VERTICAL SECTION



PLAN

Snyder Black & Sturn NY

CALCINING KILN

DOWLAIS WORKS.

SCALE

cwt. to the ton of ore. But working on the open air plan the cost of the labor expended in stacking and arranging the heaps, and watching them during the period they are under fire, amounts to 4d. per ton of raw ore. The consumption of coal will average 2 cwts. of small and ½ cwt. of large to the ton. Estimating the small to be worth 2s. 6d., and the large 6s. per ton, the cost of calcining the common argillaceous ores in kilns will stand thus:

Labor, filling	1d.
Small coal	1½d.
Interest of capital	¼d.
Cost per ton	2¾d.

On the other hand, the expense of calcining on the open air plan will stand thus:

Labor in Stacking, &c.	4d.
Small coal	3d.
Large "	1¾d.
Cost per ton	8¾.

Hence the kiln system is 6d. a ton cheaper than the open air. A difference of 6 l. per ton on the cost of preparing an ore yielding 32 per cent. of iron is equal to 1s. 7d. nearly on the ton of pig iron. Independently, however, of this sum, the effectual manner in which kilns perform the operation, enables the ore to be worked in the blast furnace with less fuel, and the resulting metal is of a better quality.

The carbonaceous ore of Scotland is calcined in large heaps, in a manner similar to that pursued with the argillaceous ores. The operation is usually performed at the mouth of the pit. From the larger per centage of carbon in the ore, calcination is effected without using more fuel than suffices to ignite the mass at one or more places. Consequent on this abundance of carbon in ores of this class, their calcination is effected at a comparatively cheap rate for the open air system. All the disadvantages, however, which result from exposure to the ever varying changes of the atmosphere, apply to this system even with greater force when carbonaceous ore is being calcined. From the comparatively low temperature at which the metal melts, it is a common occurrence to find thin plates of metallic iron wherever slight wind draughts have existed. Other parts of the heap will be found cohering together with a tenacity requiring steel wedges for their separation. In one instance which came under our notice, the heap of ore was built to a height of 20 feet, with a breadth and length in proportion. It was fired and allowed to burn for some weeks; when sufficiently cooled down the operation of filling it for the furnace commenced. A small portion, about one-fourth, was got out without much difficulty, but the remainder was found adhering together in such im-

mense masses, that they had to be blasted with gunpowder by experienced quarrymen to reduce them to manageable dimensions: even then the lumps sent to the furnace frequently weighed one ton each. The filling of the detached pieces was done for about 3d. per ton, but the labor expended in the separation of the large masses exceeded 2s. 6d. per ton of calcined ore.

We consider the employment of kilns, with careful men as burners, to be a matter of very great importance to the ironmasters of Scotland. Apart from the consideration of having the ore calcined with regularity and certainty, the use of kilns will enable the ironmaster to smelt these ores with a consumption of one-fourth of the coal now used: in other words, a ton of crude iron may be smelted from the carbonaceous ores with 10 cwts. of coal instead of 40, which is near the present average consumption.

By referring to the analysis of carbonaceous ores in the preceding section, the proportion which the carbon bears to the whole is 30 per cent. In the same ore the metallic iron amounts to 28 per cent. This may be taken as fairly representing the per-centages of carbon and metal in the carbonaceous ores of Scotland. Of an ore yielding 28 per cent. of metallic iron, we require 3.57 tons to produce one ton of crude iron. The pure carbon in this quantity of ore weighs 2,400 lbs. Under the open air system this quantity of carbon is wasted, in over heating and partially fusing the stones into large refractory masses. This carbon having been dissipated, to convert the ore into metallic iron in the blast furnace, from 38 to 40 cwts. of coal, containing 76 per cent. of carbon, is consumed in the production of each ton of crude iron. Hence it will be seen that the carbon ordinarily contained in the raw carbonaceous ore of Scotland, but which is now utterly wasted during their calcination, is not greatly inferior in weight to the carbon contained in the fuel subsequently added, in order to effect their fusion and reduction in the blast furnace.

We are very far from supposing that the whole of the carbon combined with the ore can be retained and used in the operation of smelting; but we are of opinion that the quantity we have stated will be amply sufficient to compensate for any loss during calcination.

That the carbon can be retained in the ore during the process of calcination, if the operation be carefully conducted, in properly constructed kilns, there can be no question. If the workmen are attentive, the heat to which the ore is subjected may be regulated with a precision unknown in the open air system. At no time need the heat be greater than is required for coking the combined carbonaceous matter, and such being the case, the retention of the carbon for profitable use in the blast furnace may be as effectually accomplished as in coal undergoing the process of coking in an oven to fit it for the same purpose.

The pecuniary advantages which will accrue to the smelters

of Scotland, by using kilns in the manner described will vary with the cost of coal. Under existing prices the reduced cost of smelting will not be less than ten shillings per ton of crude iron.

The rich oxides, such as the red hematite of Lancashire, and the brown hydrated hematite of Cornwall, seldom undergo any calcination before entering the blast furnace. This omission, in the case of these oxides, of an operation universally performed on the leaner ores of the argillaceous and carbonaceous classes, is owing to the small per centage of volatile matters which they contain. Water appears to be the principal foreign substance which a well regulated system of torrefaction would remove from these ores. Under the most favorable circumstances they contain about 6 per cent. of moisture, which it is advisable to expel before they are filled into the furnace. On numerous occasions, however, we have found these ores mixed with as much as 15 per cent. of water—a quantity positively injurious to the working of the furnace. A portion of this water may have been absorbed during the conveyance of the ores, but the largest portion is owing to inattention in the selection. When in this wet state the ores, if small and intermixed with a portion of their earthy matrix, have the consistence of concrete. Filled into the furnace by barrows, each barrowful falls a dense clotted mass, through which neither blast nor heat can penetrate, until it has descended far down into the body of the furnace.

The injurious effects produced on the working of the furnace, and the deterioration in the quality of the resulting pig iron, will be treated on when we arrive at the section on the working of the blast furnace. Meanwhile, we would impress on smelters the necessity of adopting means for expelling the water in combination.

Calcination in kilns would seem the most feasible, indeed the only way of accomplishing this desideratum on a large scale. By itself, however, the red hematite lies too heavy to be properly torrefied by the heat given out by the small coal during combustion. Its great density also prevents the ascent of the air necessary for combustion. These difficulties in the way of calcining these ores in kilns, probably is the cause of the hematites being used in the raw state. At the Dowlais works, however, the plan partially adopted some years since was, to calcine these ores in mixture with the less dense argillaceous ore. The proportion of hematite to the ton of argillaceous ore ranged from 2 to 6 cwts. With the last quantity, the kilns worked well, though not so fast as with a burden composed of the argillaceous ore alone. The beneficial effects of this operation on the hematite as seen in the working of the blast furnace were very striking; while the additional expense at the kilns, including all labor and charges was under 3d. per ton of ore.

Whatever system is employed, when ores are to be calcined,

care should be taken that the pieces deposited for that purpose are nearly uniform in size. This uniformity of dimensions is a matter of considerable importance, though it does not receive that attention which it deserves. We not unfrequently observe pieces of ore, 2 or 3 inches in the least diameter, undergoing calcination with others measuring 12 to 18 inches. With such disproportion in the dimensions, it is very evident that if the quantity of fuel is regulated to thoroughly roast the smaller pieces, it will not suffice to calcine the outside only of the large pieces. On the other hand, if the proportion of fuel is sufficient to maintain the heat for completely calcining the largest pieces, the others will have been overheated, and fuel wasted.

By experiments, we find that the time necessary to heat argillaceous ores of different dimensions to the same temperature, is nearly in proportion to their smallest diameters. Thus if the time necessary for a piece of 12 inches is 24 hours, for a piece of 2 inches it will be 4 hours; and if we pound the ore so that it passes through a sieve containing 30 meshes to the lineal inch, it will be accomplished in the short period of four minutes.

At several works kilns have been erected with a tramroad, elevated sufficiently high to allow of the contents of the wagons being discharged directly into the kiln. The plan is attended with a saving of labor—amounting in value to about $\frac{3}{8}$ of a penny per ton of ore, but otherwise we consider it a most reprehensible system. Each wagon probably holds two or three tons of ore, which fall into a single heap, over which a quantity of coal is thrown to maintain combustion. If an abundance of coal is used the stones may be withdrawn thoroughly calcined, but if the coal is proportioned to the actual requirements of a well conducted kiln, the centre of the heap will be more or less imperfect. From careful observations we are inclined to consider that filling with the shovel is eventually the cheapest mode, and the one attended with the most satisfactory results in the blast furnace.

When performed with the requisite care and attention, calcination effectually deprives the ore of the water, sulphur, carbonic acid, and other substances volatile at a certain temperature. Sudden immersion, however, into a kiln working at this temperature is attended with injury to the ore. Instead of the water being distilled it is decomposed, and the liberated oxygen unites with the metal. It is necessary, therefore, that during the progress of the operation the heat be gradually advanced to the point which experience has proved to be most advantageous for the complete expulsion. In the large way this is provided for in kilns, by maintaining the greatest temperature below the surface of the incandescent mass; in the open air system, by the slow rate at which the combustion proceeds from the original fires.

If the operation is conducted for too long a period, or if the temperature employed is too high, the ore will be less or more in-

jured. When the water, carbonic acid, and other volatile substances are expelled, the operation is complete; if it is continued after this point the stones gain weight by the absorption of oxygen, and is more difficult of fusion than the properly roasted stone. In extreme cases the increase of weight, by the fixation of oxygen, will amount to 7 or 8 per cent. Too much care, therefore, cannot be taken in the preparation of the ore for the blast furnace where the quality of the metal and cost of smelting are deemed objects of importance.

When properly calcined, the argillaceous ore is of a light reddish color throughout, friable, and splitting into imperfect lamina. In the partially calcined stone the depth inwards of the reddish color shows the extent of the calcination. Whatever this may be, if it is short of complete calcination, there will be a portion of the stone, towards, or in the centre, of a deep blue black color; and if the operation has been so imperfect as to leave a considerable quantity unaltered, the centre will retain its former gray or indigo blue color unchanged. The breadth and presence of each band will show the degree to which the heat penetrated. If we perform the operation with pounded ore on an iron plate, the ore is observed to gradually turn black, as it absorbs caloric, but on allowing it to cool this color finally changes into a light red.

With the expulsion of the volatile ingredients the ore is found to diminish considerably in weight. This loss of weight by calcination varies with the composition of the ore; in some it is as high as 60, while in others it is as low as 6 or 7 per cent. of the original weight. With the same class of ores the loss is generally in an inverse ratio to the yield of metal.

Argillaceous ores lose from 20 to 33 per cent.; the mean of 18 essays was 27 per cent.

Carbonaceous ores lose more than others: the amount varies in different stones, but is seldom under 28 per cent.; stones containing a large percentage of carbonaceous matter lose from 40 to 50 per cent.; in one specimen which we examined, and which is extensively used in Scotland, the loss reached 60 per cent.

Calcareous ores lose weight according to the lime in combination. The average loss of stones of this class may be taken at 31 per cent. Silicious ores vary from 15 to 35 per cent., according to the metal.

The rich hematites of Lancashire and Cumberland lose about 6 per cent. in weight in passing through the kiln. The hydrated hematites of Cornwall, Devonshire, and other districts, from 12 to 15 per cent. when clean; but if these ores are mixed with much extraneous matter, which, unfortunately for ironmasters, is now too often the case, we have known them to lose 32 per cent.

PREPARATION OF THE FUEL.

It is but a few years since raw coal was first adopted as a fuel in smelting. Previously, the preliminary process of coking was

considered as indispensable to the success of the smelting operation; and in the majority of the iron making districts this erroneous impression prevails at the present day. The causes which have contributed to perpetuate the system of wasting a large portion of the calorific power of the coal in the coke yard will be the subject of a separate section—XIII.

In the process of coking the coal is exposed to a slow combustion, by which the volatile gases are expelled, and the carbon retained for use in the furnace. If carefully conducted, the loss of carbon is not great, but in the ordinary way of coking, from one-fourth to one-half of the carbon is dissipated, and the calorific power of the coal in the furnace is reduced to this extent.

The operation is usually conducted in the open air; large quantities, however, are prepared in brick ovens, variously constructed, according to the qualities of the coal, mode of working and science displayed.

PREPARATION OF THE FLUX.

The limestone used as flux, is usually charged into the furnace in the state in which it comes from the quarry, the preliminary operations being limited to reducing the dimensions of the blocks, that calcination may be the more readily effected. In a few establishments, however, the stone is calcined in kilns, by which the water and carbonic acid is expelled, and the lime obtained in greater purity. The process is performed in kilns, of the construction employed for the calcination of the ores, and is conducted throughout on nearly the same principles.

ART. II. REMARKS ON THE OFFICIAL REPORTS OF THE INSPECTORS OF COLLIERIES TO THE ENGLISH PARLIAMENT. BY M. HERBET, CONSUL GENERAL OF FRANCE IN LONDON.

BY virtue of an Act of Parliament, adopted in 1850, the various coal regions of Great Britain are divided into six departments, which have been classed according to their relative geographical position, as follows:

1. Scotland.
2. The counties of Northumberland, Durham, and Cumberland
3. The counties of York, Derby, Warwick, Leicester, and Northingham.
4. Staffordshire, Shropshire, and Worcestershire.
5. Lancashire, Cheshire, and northern part of Wales.
6. Southern part of Wales, and the counties of Monmouth, Gloucester and Somerset.

Each of these districts is placed under the surveillance of government inspectors, charged to report periodically to the Minister of the Interior detailed accounts of accidents occurring in the collieries. It is a part of their duty for the time being, to regulate all improvements relative to the ventilation, the healthiness of the mines in general, and all ameliorating circumstances relating to the physical or moral condition of the mines. It is in this point of view, especially, that their inquiries possess undeniable interest.

The last report addressed to the Secretary that has been laid before Parliament, and which has come to hand, is worthy of particular attention—especially that portion which treats of the ventilation of mines, and gives a sketch of a series of experiments, undertaken in several collieries and destined to establish the superiority of the *steam jet* as a means of ventilation surpassing all others.

The regulations in force in mines of the most fiery nature, as well as those proposed by the inspectors themselves, are deserving of consideration.

The inspector of the district, comprising Lancashire, Cheshire, and the northern part of Wales, who was appointed with one of his colleagues, to visit the coal regions of Belgium, Germany and France, has made between the former country and England a series of curious comparisons in connection with a statement of the number of accidents in the collieries, respectively.

For the years 1851, 1852, 1853, the average annual number of deaths from accidents, is put at 215 in Lancashire, Cheshire, and the north of Wales. By taking as the basis of comparison the number of workmen in 1852, the proportion is 5.55–100 to the thousand.

The collieries of Belgium present difficulties in mining not inferior to those of the districts in England; they do not furnish, however, from 1845 to 1849, an average of more than 3.14–100, estimating the number of miners in the country at 46,000: in 1851 and 1852 the proportion, although greater, did not exceed 4.5–100 per thousand. Two facts might conduce to this result: the relatively smaller product of the mines in Belgium, and the comparatively smaller number employed in the heart of the mine. But, on the other hand, the substitution of machinery for manual labor is far more general in England than in Belgium. If we should compare the quantity of coal mined in the two countries, for each man killed, it would be found to be much the largest in the English district. Thus in Lancashire, Cheshire, and the north of Wales it was 46,000 tons, and for all Great Britain 54,822. It is hardly necessary to observe that this result is but an approximate one, and may vary somewhat from the absolute fact. But it is based upon the estimates of a competent man, Mr. G. Dickinson, member of the Geological Society and inspector of colleries.

The yield of coal is estimated at 54,000,000 tons, and is thus distributed:

Northumberland, Durham, Cumberland,	11,000,000
Lancashire, Cheshire, and north of Wales,	10.000,000
Staffordshire, Shropshire, Worcestershire	8,000,000
Yorkshire, Derbyshire, Warwickshire, Leicestershire, and Nottinghamshire,	7,500,000
South Wales, Monmouthshire, Gloucestershire, and Somersetshire,	10.000,000
Scotland,	7,500,000
	54,000,000

The report of the same inspector presents the following facts. The number of collieries in Lancashire, Cheshire, and North Wales, is 423:

Lancashire,	334
Cheshire,	28
North Wales,	61

Some employ only a small force, while others have 1,000 to 1,500 miners, and produce annually from 300 to 350,000 tons of coal. A single firm, that of Andrew Knowles and Sons, the most extensive operators in Lancashire, produce daily the enormous quantity of 2,400 tons.

The number of pits or shafts, not including those used exclusively for ventilation, exceeds 879 in this district of Lancashire, Cheshire, and North Wales. Some of these pits have a depth of 475 metres.* Their depth is on an average 110 metres. In Cheshire 50 pits have an average depth of 112 metres; while in North Wales, of 150 pits, the depth does not exceed 90 metres. The general average depth of all the pits is 104 metres.

The power used in this district consists of 846 steam engines, used exclusively underground, besides hydraulic machinery, horses, whims, &c.

In most of the collieries the hoisting is done with hemp cables, but the use of wire ropes is beginning to supplant them. Broad chains, with triple link, are commonly used in North Wales. We find also the simple chain, but it affords little security to men. The pits are furnished with guides, either of wood or wire rope. In some pits an endless chain, which connects with all the galleries, is used. Below a certain depth their use appears to be attended with danger, sufficient to prevent a general adoption of them.

The following is an approximate estimate of the yield of the collieries in Lancashire, Cheshire, and North Wales, in the year 1852. It is entitled to greater confidence from the fact that a large amount of the statement was furnished by the proprietors themselves.

* The metre is about 39 inches.

Lancashire,................	8,255,000
Cheshire,.....................	715,000
North Wales,.................	953,000
	9,923,000

With the exception of about a million tons, this enormous quantity of fuel appears to be consumed in the district, independent of the importations from South Wales, the county of York, &c. The export from Liverpool during the same year was 383,597 tons—105,952 to the United Kingdom, and the remainder to foreign countries. To this amount should be added the quantity sent to other parts from the district. Thus 50,000 tons was sent by railway from Lancashire to London and the south of England.

In 1852, the population employed in the collieries under the inspection of Mr. Dickinson amounted to 38,800 persons, of these, 31,950 were employed under ground, and 6,850 on the surface.

It must be admitted that the quantity of coal mined by each person cannot be determined only approximately. It varies according to places and mode of working. It is estimated to average, for the year 1852, 310 tons for every underground miner. In North Wales it is only 222 tons, but in Lancashire and Cheshire it reaches as high as 324 tons. It is estimated that an ordinary collier from one of these counties can mine about four tons per day. But each one of these is assisted by a drawer to transport the coal to the ways of the mine; and if we add to this class of workmen the numerous other classes of laborers, all of whom go to reduce the average product for each individual, and also consider the odd day allowed the miners every fortnight which is reckoned, we shall not be surprised that the general average is not larger.

The seams actually worked vary in thickness from 11 inches to about 10 feet. The greater number measure from 3 to 7 feet.

The report of Mr. Charles Morton, inspector of collieries in Yorkshire, Derbyshire, Nottinghamshire, Leicestershire and Warwickshire, without being as circumstantial as that of Mr. Dickininson, contains many interesting facts. This district extends from Leeds on the north, to Coventry on the south, and comprises 440 collieries.

The number of pits open is about 800, the majority of which have steam engines. A number of the pits are less than 91 metres in depth, while some exceed 228 metres. The seams vary in thickness from 18 inches to 10 feet.

Messrs. Lancaster & Williams, inspectors for Scotland, estimate the number of persons employed in their district at 21,700 in 1853, and the amount of coal yielded the same year at 7,132,000 tons.

ART. III.—THE METALLURGICAL TREATMENT OF THE ORES OF COPPER (GRIS) AT THE SMELTING WORKS, STEPHENHUTTE, UPPER HUNGARY.* BY JULIUS JUHOS.

No part of the Austrian monarchy can furnish to the miner such interesting subjects of investigation as the district of Schmoelnitz in the northern portion of Hungary.

The principal chain of mountains, composed of ferruginous schist and graywacke, contains numerous and powerful veins of quartz and carbonate of iron, in which are metals of great value, as quicksilver, copper, cobalt, nickel and silver.

These metals are combined with sulphur and antimony in various degrees. Their treatment is always exceedingly difficult, and is deserving of the serious consideration of metallurgists.

The extraction of copper and silver is one of the oldest pursuits of the inhabitants, and has proved for many ages a chief source of their enterprise and wealth.

The smelting works were at first under the management of inexperienced operators; afterwards, and for a long period they were under the charge of engineers of the government, but now they are the exclusive property of a powerful company, known as the "Association of the Miners of Upper Hungary."

The president of this Association is Count George Andrassy, who has been able to conciliate the interests of the numerous proprietors of the mines, and who should in truth be regarded as its founder.

The most important operations there relate to the extraction of mercury, and the treatment of the argentiferous gray ores of copper by the amalgamation of coarse copper. Metallurgical science is indebted to the processes used by Thonhauser, Charles Kovarts, and Baron Leithner. The explanation of the method followed at the smelting works of Stephanhütte cannot fail to be of interest.

The ores received at the furnace come from a great number of mines. They are divided into two classes. 1st. Ores containing mercury. 2d. Ores not containing mercury. Each of these is again subdivided into argentiferous ores, and non-argentiferous ores. Thus four classes are obtained which are treated separately.

ORES CONTAINING MERCURY.

Both classes of ores which contain mercury are roasted in half closed ovens (Rostadel). They are placed in the lower part, and covered with a layer sufficiently thick of (menus).

The fire is conducted quite gently, and the upper layer continues cold until all the mercury is condensed. When the roasting is

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completed, the upper layer is separated and passed over sieves to separate the quicksilver, and the residue passes with the other mass of ores into a new heap for roasting—upon which an upper layer or coating is formed with fresh (menus).

The ores imperfectly roasted, but entirely deprived of mercury, are sent to the smelting furnace for copper only, or to that for copper and silver.

The treatment for mercury is extremely simple and very economical. It yields 90 to 100 per cent. of metal indicated by the assay.

When the mercury has been extracted only two classes of ores remain, those which contain silver and those which do not.

ARGENTIFEROUS ORES.

The treatment of the argentiferous ores embraces the following operations:

1st. Fusion from raw ore yielding a matt called Rohlech.

2d. Roasting of the mass from eight to ten heats (feux).

3d. Smelting for coarse argentiferous copper called durchstecharheit.

4th. Amalgamation of the coarse copper.

Smelting of regulus from raw ore.—The operation is performed in (half high) furnaces; the charge is composed of ¾ roasted ore, and ¼ raw ore. Some add from from 12 to 14 per cent. iron pyrites; 12 to 14 per cent. of quartz, and 10 to 12 per cent. of slag from the smelting for coarse copper.

The ores contain from 9 to 10 per cent. of copper, and from 1¼ to 1½ loth* of silver to the hundred, or from 39 to 46 grammes † to 100 kilogrammes.

Three products are obtained.

1st. Matts, containing from 22 to 24 per cent. of copper, and from 63 to 70 grammes of silver to the metrical quintal.

2d. Speiss (Rohspeiss) containing from 24 to 28 per cent. of copper, and from 93 to 137 grammes of silver to the 100 kilogrammes.

3d. Slag, only suitable to throw away.

An assay of the products of the furnace ordinarily indicates a greater quantity of copper than that shown by the assay of the ores. The increase is from 8 to 9 per cent. The silver, on the contrary, shows a loss of 2 to 3 per cent.

The Speiss is placed aside for a special operation. The matts are roasted and passed to the smelting for coarse copper.

The charge is composed of crude matts roasted, and of second matts from a preceding operation passed to four or five heats (feux). Some add from 12 to 18 per cent. of quartz.

The products are—

* Loth, a standard weight—about half an ounce.

† Grammes, the unit of French measure.

1st. Coarse copper containing about 80 per cent. of copper in the smelted stuff, holding from 82 to 86 per cent. of copper, and from 249 to 281 grammes of silver to the quintal.

2d. Second matts (oberlich) which contain from 60 to 65 per cent. of copper, and from 78 to 93·4 grammes of silver per 100 kilogrammes.

3d. Slags, contain very often portions of the matts and ore, in such case passed over to the smelting furnace.

The second matts are roasted and smelted in a subsequent operation; the coarse copper passes to the amalgamation.

The assay of the products of the furnace for coarse copper usually indicates a loss of 3 to 5 per cent. on copper, and a trifling increase, and sometimes a trifling loss on silver.

Amalgamation of coarse copper. The amalgamation of coarse copper embraces several operations.

a. Heating to a dark red in a reverberatory oven, and pulverization in a stamping mill.

b. Reduction to flour under pulverizing stones.

c. Roasting in a reverberatory oven this flour (farine), mixed with 8 to 10 per cent. of sea salt.

d. Amalgamation, strictly so called, in revolving casks; a mixture is made consisting of 5 metrical quintals of roasted stuff; 2 do. of quicksilver; 0 qm., 50 copper balls. Cold water is used in the proportion of 15 to 18 per cent.

e. Separation of the amalgam by pressure—distillation of the mercury and melting the silver into ingots.

The operations occasion a loss of 2 to 3 per cent. in silver and about as much in copper.

The residuum of the amalgamation weighs 25 to 30 per cent. more than the coarse copper used in the operation. It contains 60 to 64 per cent. of copper and 7 to 9 grammes of silver to the 100 kilogrammes.

A portion of the residuum, about one-third, is smelted with the addition of 60 to 80 per cent. of iron pyrites. By this operation the copper is concentrated in a matt containing from 30 to 40 per cent. of metal. The mixture is roasted with 4 to 5 heats (feux) and passes, together with the residuum, unchanged to the furnace for coarse copper under the treatment for non-argentiferous ores.

NON-ARGENTIFEROUS ORES.

The ores which do not contain any silver are, at first, fused; and the matts obtained are roasted by eight or ten heats (feux), and are smelted for coarse copper in a high furnace.

The charge is composed as follows:

100 parts of crude residuum of the amalgamation.
60 to 70 parts roasted matts.
10 to 12 per cent. quartz.

The products of the smelting are:

1. Coarse copper holding 85 to 88 per cent. of pure copper, and containing from 75 to 80 per cent. of the metal existing in the mass fused.

2. Matts (oberlech) varying from 70 to 75 per cent. for copper. They are roasted and re-passed to the furnace for coarse copper.

3. Slags, which are useful in the fusion of regulus from raw ore.

The coarse copper is refined in a reverberatory, and the clots or slags of the refinery are divided into two classes—poor and rich slags or clots.

The poor slags are placed at the same time with the non-argentiferous ores, with the addition of iron pyrites into the furnace for the matt. The rich slags are smelted at the same time with the roasted matts in the furnace for coarse copper.

TREATMENT OF SPEISS.

The treatment of the argentiferous ores yields annually 1200 metrical quintals of antimonial speiss, containing at least 300 quintals of copper and 100 kilogrammes of silver. Two distinct methods are proposed for extracting the two metals.

First Method.—The speiss mixed with about 50 per cent. of iron pyrites is roasted in a heap, and afterwards smelted in a half-high furnace. The operation gives a matt containing 48 to 50 per cent. of copper, and from 434 to 465 grammes of silver to the 100 kilogrammes. The loss is reckoned at 6 per cent. of copper and 9 per cent of silver.

The matts are amalgamated by the method used for coarse copper, and the silver is extracted with a loss of 10 per cent. The residuum of the amalgamation is smelted anew with matt, and the matts are roasted and smelted for coarse copper. The product is subjected to two successive refinings before it is sent to market.

The slags of the first refining are too highly charged with antimony to be useful; those of the second refining are treated like those from the refining of coarse copper.

Second Method.—The speiss is pulverized with stamps and roasted in a reverberatory. Some close the operation with charcoal, for the purpose of driving off a greater quantity of antimony.

It is afterwards mixed with a considerable proportion of pyrites, from 70 to 80 per cent. and melted to matt.

The matt is roasted and melted for coarse copper.

Two products are obtained. Some speiss very rich and some coarse copper very impure. Both are separately amalgamated. This second method is still an experiment and no one can assert that it is more advantageous than the first method.

A different process has been proposed by Roszner, the Inspec-

tor of the Imperial Smelting Works. It consists in smelting the pulverized speiss with potash, and treating the melted matter with water. The greater part of the antimony is dissolved, and the residuum is easily treated for copper and silver.

This process has not yet been adopted on a large scale, but it must soon be tested.

Art. IV.—THE MINING OF COAL,* &c., &c. By A. T. Ponson. No. 1.

Introduction.

Coal, which holds the first place among useful minerals, has become an indispensable article of production in the industrial arts. The mines from which it is obtained, have been so far developed within the last twenty years, and their working has been made an object of such vast and numerous improvements, as to entitle them to a distinct and special investigation; accordingly the writer, putting aside all thoughts of the incombustible minerals in the earth, has believed it to be a duty to devote his attention exclusively to the different methods adopted for mining coal, and to the accessory operations connected therewith.

This treatise, although written on Belgian ground, presents nevertheless a constant parallel between the equipments and processes usual throughout all the carboniferous basins of Europe. It contains not only an explanation of the methods of operation and the machinery which are the most recent, but likewise a notice of those anciently adopted; thus the reader can comprehend at a glance a complete history of the inventions designed for mining purposes at different eras.

The first chapter contains some practical observations upon carboniferous rocks and the superincumbent strata of coal seams—a description of some remarkable coal basins—and an explanation of the steps adopted in searching for coal veins and the indications of their existence. But this summary of the application of geology, and of (boring) to the labors of the miner, will not enable inquirers to dispense with the study of those special sciences from which these observations are gathered.

The means for extracting coal out of the earth, that is, the digging of shafts and galleries, through every kind of strata, the

* A treatise on the Mining of Coal, or a comparative explanation of the methods adopted in Belgium, France, Germany, and England for the working and mining of coal, by A. T. Ponson, Civil and Mining Engineer. Translated from the French for the Mining Magazine. Copyright secured.

supporting of them, the methods by which to prevent the irruption of water into them, &c., &c., form the subject of the second chapter.

The principles contained in the first sections of the third chapter, relate chiefly to the treatise on ventilation, by Mr. Combes.* This treatise could not have been overlooked, since the only satisfactory theory of ventilation, a subject upon which previously only the most crude notions were entertained, owes its developement in a great measure to the investigations of this accomplished engineer. These scientific principles, to which some new observations have been added, are accompanied with descriptions of the furnaces (foyers) and almost all the mechanical apparatus for ventilation in use even to the present time.

Two methods have been introduced by which to test the utility of these contrivances. By one, we compare the advantages deduced from experiment, with the power exerted by the machine. The other, independent of the power exerted, consists in an analysis of the forces exhausted by the resistance to ventilation, and thence is determined the fraction of utility. The experiments which have served as a basis for these calculations, owe their origin, in a great measure, to M. Jochams, an engineer of the royal corps for the Belgian mines.

In reference to illumination, the author describes open lamps and safety lamps, and comprises among the latter, every kind of lamp which has met with any success in coal mines.

In a word, this chapter closes with a description of internal fires, and the most suitable means to be used to extinguish them, among which he notices the use of carbonic acid in Belgium and England.

The winning of coal and the explanation of the different systems for working it, which form the subject of the fourth chapter, have been treated with that fulness to which these essential parts were entitled; and which rests for its value upon facts selected in the collieries of the various coal basins of Europe. A section is specially devoted to the implements which have been entirely separated from the consideration of the systems of working. The classification adopted is none other than that required by the progressive development of the methods adopted in the centres of mining, and commences with the formations in Belgium, and closes with English basins. This plan enables us to group the systems of working in the same locality, and to pass from them to general considerations upon the seams and the local customs. In addition, the different systems are subjected to a methodical nomenclature, based upon the general principles for the winning of coal; and the processes adopted for finding the continuation of the seam when interrupted by faults.

* Annales des Mines, third series, vols. 15 and 16.

The carriage or transport of the coal, to which the fifth chapter is devoted, is divided into three principal classes.

1. Its transport in the interior of the colliery, comprising the ways, the vehicles, and the moving power.

2. The hoisting—for which the contrivances are treated under the titles of vehicles and motive power, and an intermediate class between vehicles and motive power. One of the sections treats of the hoisting cars and the upright ways, designed to guide the vehicles from the base to the mouth of the pit. The author subsequently reviews the various kinds of motive power, and analyses the useful results obtained by the use of men and horses for the transport and hoisting; he also investigates the results arising from the force of gravitation and of steam.

3. The transport at surface, which is founded on the same principles as the transport in the interior of the colliery, and which has for its aim the greatest results.

In short, the reader will find in this chapter an account in detail of the methods in use for communication with the interior by persons without—the means of descending into, or ascending from the mines—some discussions upon the use of ladders and cars for hoisting, and a description of the apparatus known as movable ladders (*eschelles mobiles*), which is adopted for passing the mines underground and for the hoisting of coal.

The sixth chapter treats of the drainage of the galleries, and the means of protecting them from the influx of water. The construction of dams, of divers forms, and of wood or masonry, follows as a consequence. The use of pumps, lifting or force, and of single or double stroke; the moving power, &c., are all embraced under these general considerations, and also the manner of erecting them in the bottom of the pits, and the machines by which it is done.

The seventh chapter treats of the internal economy of collieries. It contains a series of statements and calculations designed to fix the cost of the first works and the materials used in mines; and estimates respecting necessary cost, raising the coal, this is for the manufacture of tools, vehicles for transport and hoisting the coal, and the erection of machines.

The advantages arising from the employment of miners from the first openings until the coal is worked, are illustrated by examples selected from various mines. These advantages generally relate to some of the labors already described in one of the previous chapters, to which they form a supplement. The various kinds of labor employed in the mines are also considered. The salaries are stated only approximately, for in their nature they are variable and cannot be treated precisely, but rather as a complement of the examples noticed. It is sufficient in all cases to estimate the price, or wages at the time, and in the particular locality where the mining is done, in order to obtain a sufficiently accu-

rate estimate, the advantage being an element hourly variable where the conditions remain the same.

Finally, some paragraphs are devoted to the consideration of the principles upon which the capital of collieries should be estimated.

In the eighth chapter the author describes the mathematical instruments used in the mines, &c. The latter sections contain a solution of numerous problems relating to winning the coal, the various methods for tracing a meridian, &c.

He has believed, in the progress of his work, that it was his duty to reject all theoretical plans, as representing illusions; galleries exactly straight and symmetrically arranged do not exist, even where they have been dug in the most favorable strata. So likewise all drawings of mines, with some rare exceptions, are accurate, and consequently show only what does exist—not what has existed.

The cuts of the maps are made on a scale of which the subdivisions are an exact fraction of the metre, a fraction which in almost all cases has unity for its numerator. All the apparatus or machinery described has received the approval of experience. It is now in operation, or has been heretofore. Such is the rule which has been observed in the preparation of the work and from which there has been no departure, except in one or two instances, where the projected machines were of such a nature that it was not possible to pass over them in silence.

The author of this work has examined almost all the documents on mines published in the French and other languages; nevertheless, the larger portion of his work being the fruit of observations made, and facts collected, during numerous journeys, and with an experience of eighteen years, is entirely new both in plan and contents. He has received a large number of communications from engineers in various countries, and especially in Belgium, and he has endeavored to make honorable mention of their names, whenever the information communicated by them afforded an opportunity.

In the year 1836 the project of this work was formed, and its execution had been commenced, when in 1843 the "Treatise on the Working of Mines," by M. C. Combes, was announced.

At first it appeared to be the author's duty to lay aside the idea of publication; but subsequently, upon comparing the two works, he perceived that his own being entirely of a practical character, and thus possessing a usefulness of its own, would have a chance to be read, and he thought, that by permitting some years to elapse, especially years so fertile in industrial discoveries, he would be able to collect new facts in sufficient number to enhance the interest of his work so much as to justify him in publishing it, even after the remarkable scientific treatise of Mr. Combes.

The result has shown the correctness of his views, so far as

relates to the abundance of new materials, and he sincerely hopes that in the other circumstances upon which he founded his anticipations it may not prove that he has been in error.

CHAPTER I.

COAL SEAMS—BORINGS—METHODS OF EXPLORATION AND DISCOVERY.

SECTION I.—*The Carboniferous Formations—Rocks in which Coal is found.*

(1.) *Carboniferous Formations.*—The various rocks which constitute the solid crust of the earth may be divided into two very distinct classes: The crystalline rocks, such as quartz, granite, different kinds of trap, porphyry, basalt, &c. Beyond a doubt, these have been in a state of fusion in the interior of the earth, and at various epochs have been elevated to the surface.

The sedimentary rocks, such as the calcareous, the sandstones, the conglomerates, &c., which are the result of chemical precipitation or mechanical forces upon substances dissolved or held in suspension in water.

The former class never contain any combustible mineral, nor does the latter except in certain special strata belonging to the sedimentary formation, and to which for this reason has been applied the general designation of *carboniferous formations*, or *coal strata.*

The localities and places occupied by combustibles in the crust of the earth, are called beds or coal seams.

The coal beds observed thus far, on commencing with the most ancient, and proceeding to the most recent one, are as follows:—

1st. The calcareous of the transition formations which are anterior to the formation of coal. Here anthracites, and some coal which is a little bituminous, are found.

2d. The coal formation, strictly speaking, which is characterized by schists and sandstone of a special nature, interposed between the transition and secondary strata.

3d. Some brief periods of the secondary epoch produce accidentally, as it were, a small number of thin carboniferous stratifications, which are unimportant.

4th. Finally, the formations of the tertiary period in which are lignites.

The last geological position, which is the most recent, embraces the irregular deposits of lignites (Braunkohle) of the valley of the Rhine, and the alternate lime and marl which constitutes the carboniferous period of the compact lignites of Provence. These strata are regularly formed, and of vast extent; and although they may be thin, yet some of them, if not in richness, at least in extent, can be compared to some of the deposits of the coal period.

The oldest formation comprises the anthraxiféris, which have

preceded the coal period. Such are the deposits situated in the west of France, containing coal a little bituminous, especially the anthracites, and in the United States.

(2.) *Names of the different parts of a seam and of the rocks which contain it.* The coal andthe sedimentary rocks which contain it, regarded in the primitive position, consist of a series of superincumbent parallelopipeds, of which the latter has taken the form of the cavities and projections of the strata upon which it reposes, whose length and breadth is variable, but almost always vast in comparison with its thickness, which is usually quite limited. When these distinct irregular solids are composed of homogeneous substances, they are designated by the term *stratifications, strata* or *beds;* an indefinite number of layers forms a *series*, the union of several of which form a bed, A. B. or a seam C. (Plate I. Fig. 1. 2).* They are more particularly called beds when the object is to denote the rocks, and thereby assigning the term *seam* to the stratifications of coal contained in the rocks. Thus we say a bed of *sandstone, or of slate,* and a *seam of coal.*

The regular stratification of the rocks containing the coal, or their arrangement in distinct superincumbent and parallel series, is conclusive of the sedimentary origin of these deposits, among which the combustible mineral has become imprisoned, in consequence of special phenomena. A seam regarded in a small extent of its surface, appears to be enclosed between two plane surfaces, but upon a more extended view it is quickly seen that its surfaces are curved, undulating in various parts, usually parallel, but at times distinctly showing where they approximate. The same is true of the walls of the seam, which preserve between themselves and the seam an almost uniform parallelism.

The bed A, upon which rests a stratification of coal, is called the wall of the seam, and that which reposes directly upon the coal is called the roof, B. But these designations are complex, for they may be applied with equal propriety to the rocks themselves, whether they form a bed or a simple layer, even if their surface is in contact with the coal.

In this manner also, the whole series of stratifications, above and below the coal, is sometimes designated.

We term the thickness of a seam its (puissance), or the distance *m n* contained between the roof and foot wall measured by a line perpendicular to the plane of its stratification.

(3). *Coal basins.* The rocks constituting the coal strata, being of

* The entire plate containing these cuts will be given hereafter. The plates accompanying this work are most extensive and complete, and will awaken in every one the highest admiration. They may be inspected at this office. They form a folio volume nearly two inches in thickness.

a sedimentary origin, have necessarily become stratified in horizontal planes, or those which sensibly approach a horizontal position; a position which has been almost always modified by the elevations and depressions to which the crust of the globe has subsequently been subjected, and which has caused the seams to occupy the abnormal situation in which they are frequently to be seen. But whether the seams and the rocks associated with them have preserved their primitive position or not, they appear to be usually moulded to the form which the strata has presented anterior to the coal formation. And, although the sedimentary deposits may have been made upon spaces extremely variable in form and extent, although they cannot generally be said to resemble a "vase" or basin, nevertheless they are so remarkable in their boundaries and in their isolation, that the name of *coal basins* has been given to them.

The external forms of coal basins present so many irregularities, that it is impossible to define them; indeed, they are so various, that, in this respect, these deposits have no resemblance. However, we may form a general idea of them, by looking at Fig. 7, Plate I, which presents a horizontal plan of a basin, theoretically exempt from every dislocation or fault. We perceive the seams above one another, and projecting in concentric ellipses, of which the axes decrease according as they are observed from a position nearer the centre of formation. The cuts 6 and 9, being vertical sections of the same basin, show the manner in which it and the accompanying rocks were deposited toward the earth's centre, and the less they elevated from a horizontal plane, so the more rapidly were they deposited. *Concave* basins are the most common; however, we meet with others, such as are represented by Fig. 8, whose convexity is upwards, and in which the seams were deposited lowest near the borders of the formation.

Coal deposits forming regular basins in outlines and appearance, such as these we have mentioned, are rarely to be found. But it was impossible in any other manner to present a general idea of these deposits. The reader must modify this idea, inasmuch as it is too absolute, by means of the actual profiles of formations which will be described hereafter.

As observation has compelled us to recognize two distinct modes for the aggregation of the rocks of the coal formation, geologists have been led to divide coal basins into two classes.

The *lacustrine* (resembling those of lakes) basins composed of deposits made in circumscribed spaces, forming actual lakes, of which the rocks are the transition strata and the granites which contain them, or as M. Beaunier describes it, *the debris of the vase* (*basin*) *which contains them.*

The *marine* basins, such as the grand formations of Belgium and England, the result of the sedimentary action of seas, which

rest on the limestone (anthraxifere) or upon the mill stone grit. They are characterized by a degree of tenuity and trituration in the constituent elements of their rocks, such that it is impossible to trace their origin, either by the uniformity or permanency of their characters. The existence of some marine fossils has been the cause of assigning to them a marine origin, and especiailly in consequence of the conformity and occasional alternation of their strata with the carboniferous limestone, so rich in shells and polypi of that species.

(4). *Rocks associated with coal, properly termed the coal series.*—To this series belong most of the basins (*lacustres*) of the centre and south of France, the marine beds worked in England, in the various parts of central Germany, and the immense deposits which extend from Wurm to Valenciennes, and perhaps even in the south part of Wales. In brief, they comprise all the remarkable basins of Europe, where any coal mining of importance is done, and they alone will occupy our special attention in the course of this work.

The rocks, which in these formations, contain the coal, are formed of the same elements as granite, to wit: Quartz, feldspar and mica, and come from the series existing prior to the coal epoch. These rocks, formed mostly by aggregation, are as follows:—

1. *Slates and argillaceous slates,* among which we find two accidental varieties most valuable for certain industrial pursuits: the *refractory clays* and the *bituminous slates.*

2. *The psalmites* existing principally in the marine formations, and holding the place between the slates and the sand-stones, and vice versa.

3. *The sandstones,* which, according to the coarseness of their elements are divided into *fine* sandstones, or sandstones proper, and *arkoses,* sandstones of coarse grain; and pudding-stone (*poudingues*), and conglomerates.

4. *Carbonate of iron,* certain porphyritic masses, and accidental substances.

The sandstones and the slates have a common origin; they are formed from the same elements, but the constituent fragments are better preserved and more easily recognized than those of the clay slates, which are reduced to extreme tenuity, and in which the feldspar has undergone a high degree of decomposition.

The rocks of the three former classes belong exclusively to those of aggregation; those of the fourth class, are ranked with the series of igneous origin, or with substances formed by the chemical precipitation of their principal elements primitively dissolved

in water. Coal is a rock * interstratified between the slates and the sandstones with which it alternates. Its principal element is carbon. A more particular notice will be taken of it further on in these pages.

The conglomerates so abundantly spread at the base of the *lacustral* (lacustres) formations, the pudding-stones, and the coarse sandstones which come next, all appear to be strangers to the marine deposits. It is rare, indeed, that we find in the latter, sandstones of which the grain is so coarse as to permit it to be called pudding-stone. These series, almost exclusively composed of the slates, fine sandstone † and psalmites which hold the place between them, have been designated as schisto-psammitico.

(5.) *The Slates or clay slates.*—The clay slate is a tender rock, composed of elements reduced to such a state of tenuity and decomposition as to have become almost imperceptible. Their leafy structure is like that of innumerable small stratifications, of which the color, hardness, and fineness of grain are exceedingly variable, in consequence of small layers of mica, in cases generally very rare, where that substance is visible in the midst of the mass, or in consequence of innumerable vegetable impressions interspersed between the leaves or layers especially, in consequence of the property which this rock possesses of expansion by the absorption of moisture from the atmosphere and of crumbling or slaking when exposed for some time to the influences of the air. The surface of the layers in consequence of these influences are as soft and unctuous to the touch as common clay.

This rock is the most highly colored of those of the formation. It is gray, brown, and often of a black sufficiently intense to be ascribed to the absorption of bituminous matter. This color is destroyed by the action of fire.

The slates are most frequently in contact with the coal to which they form the foot wall and the roof; in consequence we often find a vegetable accumulation in the joints of stratification, and their slaking tendency is more or less modified by the carbon with which they are charged.

In insensibly passing to the state of psalmites, their nature undergoes a change. They become a plastic clay, easily dissolvable, and which does not require exposure to a humid atmosphere in order to crumble. It is in the marine formations, which are composed of elements more highly triturated, and especially in the English basins, that this variety of clays is most frequently met with. The beds are not generally very thick or extensive. The color is gray, when in a state of the greatest purity, thence

* Rock, is a technical term in geology.

† The miners of Belgium designate the second of these rocks by the term *guerelle*, and the first by that of *roc*.

it insensibly changes to black, according as it is charged with carbon and its purity diminishes. In its refractory state it is extensively manufactured for various purposes. In England and the United States, where it is found interstratified beneath the coal to which it forms the foot wall, it is denominated *fire clay.* Thus in Clackmannanshire, a county of Scotland, the coal seams rest on a bed of clay which is very valuable for the manufacture of fire-proof brick. The thickness of the bed is between 30 and 39 inches, and it almost always contains some iron in the lower portion. In some parts of the Newcastle coal district we find a clay slate which is hard, of a deep gray, or dark color, and is used in the manufacture of earthen ware and fire-proof brick. The clay of Stourbridge, near Dudley, is manufactured into crucibles for glass-houses, and bricks for making ovens used for the fusion of steel, &c. In short, this class of substances is very little known in the great belt of Belgium, whether it is at the base of the formation or in the alternates between the coal series and the carboniferous limestone. They are worked at Ardennes, near Huy, on the Meuse, and applied to innumerable purposes, such as ovens for the fusion of zinc, and crucibles for the numerous glass-houses in the district of Charleroi.

The bituminous slates, another variety of argillaceous rocks, are met with only in the upper part of the lacustrine basins, and always resting on seams of coal which burn with a blaze, or are highly oxygenized. They have less tendency to slake, are more compact and sonorous than the ordinary slates, of which they possess all the external appearance. They blaze, and in burning yield a thin smoke, and leave as a residuum, or for ashes, pure slate, discolored and reduced to leaves or thin slices. The dark color peculiar to them is caused by bituminous emanations from the combustible mineral beneath. These slates, which are very abundant in some parts of the basin of the Seine and Loire, yield on distillation, from two to four per cent. of mineral oil, called (*huile de schiste*) slate oil, that is used for illumination.

(6.) *Psalmites and sandstones, of the coal formation.*—The sandstones are formed of all the principal constituents of the rocks of the transition period : quartz, feldspar, and mica. Their color is white, gray, pale blue, more or less micaceous, and they are often tinged yellow, red and brown, by an impregnation of iron. They present in a mass all the graduations from the finest to the coarsest grain. To this circumstance and the more or less perfect aggregation of their particles, we must ascribe the numerous varieties of this species of rocks, and in those in which most elements exist, quartz chiefly prevails, and they are consequently more firm and dense. In this respect especially, we notice a great difference of texture ; sometimes they slake, break into pieces and crumble between the fingers ; sometimes they present-

to the tools of the miner such an energetic resistance, that only by expending time and labor he succeeds in breaking them away. Often even large numbers of sharp tools are rendered unfit for use, and the work advances only a few inches during twenty-four hours of severe and continued labor. Silica is the cement which agglutinates the elements, and as it combines with them in variable proportions, it produces endless modifications, and causes insensible gradations between the clay slates and these rocks, of which the principal varieties are the following.

1. Psalmites, fine-grained, homogeneous sandstones, variable in color and density; they absorb moisture from the atmosphere with different degrees of avidity, and crumble with more or less readiness. When, in consequence of the interposition of mica between their layers, the schistose nature of their texture is increased, they become brittle and crumble readily. There are *schistose psalmites.*

2. The sandstones of the coal formation strictly speaking, are white, yellowish, gray, and sometimes blackish by the effect of carbon. Their grain, uniformly very fine, in the midst of which are some specks of mica, is cemented by a quartzose element, which often renders them very valuable for many industrial purposes. The rocks of this nature of a gray color, passing even into white, which are quarried at the chateau of Namur, are used for paving-stones, grinding-stones, &c. Some very ancient churches of the city of Liege have been built of the coal-bearing sandstones in that locality. A bed of sandstone about 26 feet in thickness supplies all England and a portion of the continent with the best whetstones which are known.

The beds of these rocks are generally very thick and very uniform, where the quartz prevails, and in some an increase of mica cause a disintegration, which places them among the psalmites.

3. The coarse-grained sandstones, more particularly those deposited in the lacustrine basins, whose constituent fragments are of such size that we can easily recognize the nature of the series where they originated. Such are the *arkoses*, whose elements have the coarseness of pebble-stones. The pudding-stones, composed of boulders strongly agglutinated, and the irregular and massive beds of conglomerates.

(To be Continued.)

Art. V.—FUEL AND ITS APPLICATIONS.*

What is fuel? Let any one attempt to answer the question, and the comprehensiveness of the subject becomes manifest. It is easy to express in general terms its uses, as warming, heating, illuminating; or to define its nature, as vegetable, artificial, mineralized and fossil; but descend a step lower in the detail, and name the various articles of fuel, their properties, the manner of their production, the incidents attending the same, and the various methods for their application, with the results, and the extent of the subject in its practical aspect begins to be apparent. Turn, now, from this dim and imperfect idea thus formed, to two volumes, containing more than eight hundred pages, devoted more directly to the explanation of the applications only of fuel, and illustrated by some hundreds of engravings, all of which are the work of men illustrious in science and art, and the importance of fuel and its applications, appears to be such as to impress even a novice. To those who are interested in the subject in any of its thousand forms, or who have large investments connected with some mode of its application, or who are investigating the nature and products of fuel, as opening a comparatively new field in this country, we offer the invitation to accompany us somewhat hastily and cursorily through some of the varied pages of these volumes. Suffice it to say, that it is a work keeping pace with the progressive advance of science, arts, and manufactures, such as has long been desired by scientific as well as practical men. The two parts of one volume forming the commencement of "The Library of illustrated Standard Scientific Works," now in course of publication, are devoted to fuel and its applications. In addition to the editors, there are among the contributors, Robert Stephenson, who furnishes illustrations of the furnaces of locomotive and marine engines, and information on the consumption of fuel in the former. Another contributor furnishes valuable details on the manufacture of the products from peat; others present the importance of the manufacture of paraffine oil. Several high authorities have furnished information on coal gas, while numbers have responded to queries touching the special processes of manufacture, and have also liberally furnished specimens of coal for microscopical and chemical examination. In its pages will be found the results of the governmental researches into the chemical nature of coal, especially with reference to its adaptation to the

* Chemical Technology; or, Chemistry in its applications to the Arts and Manufactures. By Edmund Reynolds; Prof. of Chemistry in Queen's College, Galway, and Dr. Thomas Richardson; with which is incorporated a Revision of Dr. Knapp's "Technology." Illustrated with four hundred and thirty-three engravings on wood, and two colored and four plain plates. 2d Edition; Parts 1 and 2; Fuel and its Applications. 8vo. pp. 886; London and New York. H. Baillière.

generation of heat, and also of the recent legislative measures in England aimed at the prevention of the smoke nuisance in cities. The several combinations of organic matter which constitute fuel, with their elements, and their respective capacities for generating caloric, are here fully illustrated. Elaborate explanations are given on the production and preparation of charcoal, the charring of peat, with the most improved processes for the purpose, and the most approved form of kilns, and on the subject of lignite charcoal. The remarks on the carbonization of pit coal and its desulphurization in coking, especially as the presence of sulphur or pyrites is so injurious where coke is employed for locomotives, or in re-melting iron for foundry purposes, we insert in full:—

CARBONIZATION OF PIT COAL.

General Principles. The products resulting from the charring of coal, although similar in kind, differ considerably from those obtained under the same circumstances from wood. This might reasonably be anticipated from the different elementary composition of the two substances, the dissimilar arrangement of their elements, with addition of nitrogen and sulphur (contained in pyrites), and the higher temperature required to complete the carbonization. The nature of the products very much depends upon this latter circumstance, or the degree of temperature employed. In addition to the solid coke as residue, both liquid and gaseous compounds are produced; the former being distinguished into an aqueous and oily portion, the latter containing many of the compounds found in wood tar, but also numerous other bodies which we shall notice in another place. As a general example of the products of the dry distillation of coal and their relative quantities, the following analysis in which a slow distillation was pursued in a close vessel, may be adduced:—

	Coke,		68.925	
Liquid Products.	Tar,		12.280	—19,799
	Water,		7.569	
Gaseoctus Products.	Light carburetted Hydrogen,	($C H_2$)	7.021	11,2.16.
	Carbonic Oxide,		1.185	
	Carbonic Acid,		1.078	
	Olefiant Gas, ($C_2 H_2$.)		0.758	
	Sulphuretted Hydrogen,		0.549	
	Hydrogen,		4.099	
	Ammonia,		0.211	
	Nitrogen,		0.035	
			100,00	

The relative properties of these products, as well as the nature of the tar and water, vary with the temperature employed. When the charring goes on with the access of air, a portion of the coke as well as of the gaseous products of the distillation, is consumed in carbonizing the remainder.

The residue after the action of heat upon pit coal, is commonly called *coke.* Coals may be subdivided with reference to the production of coke, into two classes, the *coking* and the *non-coking:* the small of the latter are useless, unless mixed by mechanical means in certain proportions with the small of the coking coal, as has been proposed by Mr. Budd.

On the continent, those who have examined coal with reference to the property of coking prefer to classify it under the heads of *caking*, *sinter*, *and sand coal:* for the latter two denominations we know of no corresponding terms in English.

Caking or coking coal is that variety which, when strongly heated, undergoes a kind of semi-fusion while parting with its volatile ingredients, the separate pieces caking together to form one solid mass.

Sinter coal approaches nearest to caking coal, but the fusion of the separate pieces into one is not so perfect.

Sand coal produces coke that retains the form of the original coal without caking.

These varieties are distinguished from each other and from anthracite by their elementary composition; upon which, indeed, their caking properties very much depend, as will be seen by the following table, which shows the mean composition of the organic portion of the varieties of foreign coal, arranged according to the above classification:*

	Carbon.	Hydrogen.	Oxygen.
Sand Coal,	77	5	18
Sinter Coal,	83	5	12
Caking Coal,	87	5	8
Anthracite,	95	3	2

It will be observed that the amount of hydrogen in the first three varieties is identical, while the oxygen diminishes as the property of caking is developed; but this last, when both oxygen and hydrogen are very much diminished. But an excess of hydrogen, which has been supposed by some to be chiefly instrumental in imparting the caking property to coal, is not alone sufficient to account for this property in all cases, as will be more clearly seen by some analyses of Regnault, made expressly to determine this point, and in which great attention was paid to the character of the coke obtained from each variety of coal. The analyses alluded to have been given in detail in former tables; we have here calculated formulæ from them, assuming the same quantity of carbon in each in order to show the relation of the other elements more distinctly.

		Rel. of H. to O.
Anthracite from Balduc,	$= 80\,C. + 44\,H. + 0$	14 : 1
Coal from Blanzy, sinter coal,	$= 80\,C. + 64\,H. + 6\,O$	10·7 : 1
Cannel Coal, from Lancashire, sinter coal,	$= 80\,C. + 64\,H. + 3\,O$	21 : 1
Coal from Mons (flenu) caking coal,	$= 80\,C. + 120\,H. + 5\,O$	24 : 1
Coal from Grand Croix, (Maréchal) highly caking,	$= 80\,C. + 56\,H. + 3\,O$	18·7 : 1

It will be seen that the property of caking generally increases with the quantity of hydrogen and oxygen, particularly with that of the hydrogen. Anthracite consisting almost entirely of carbon, may be viewed as a kind of natural coke; the quantity of hydrogen rises in the others in proportion as they soften in the fire, with exception of the last, which possesses this property in the highest degree, although its hydrogen amounts to only half the quantity contained in the caking coal from Mons.

The same fact has been remarked with the younger coal of Obernkirchen, which is also of a highly caking character. It also produces a porous, friable coke, and has the composition $80\,C + 52\,H + 3O$ or $O : H = 1 : 17$.

An explanation of this property of the coal can, therefore, only be expected from an investigation of its constitution, or the arrangement of its elementary molecules, a subject upon which science has thrown no light. The proportion and nature of the ash left by the coal has also some influence upon the caking property, as will be again adverted to in describing the manufacture of coke.

The foregoing remarks are also quite opposed to the observations on our English coal. The Scotch gas coals, for example, yield little or no coke, and the best steam coals are inferior coking coals, while both contain a large percentage of hydrogen.

DESULPHURIZATION.

The production of coke is undertaken with the same general objects in view, as the production of wood charcoal; but it is desirable, for many purposes, to free the coal from sulphur. In this sense, the production of coke may also be called the desulphurization. For purposes connected with the arts, coke

must be compact, in large pieces, not liable to crumble and form dust, and it must possess a certain degree of solidity, so as to withstand the pressure of smelting furnaces. Both qualities must be considered in the choice of the material selected for its production. Experience has proved that the softness of coke is very much dependent upon the mode of its production, and that it may be rendered more compact by management in the ovens. If, for instance, coke is prepared under considerable superincumbent pressure, the blisters which form in the softened coal are pressed together, after the escape of the gases which caused them, and a denser coke is produced, while the long-continued heat of some ovens tends to render the coke more dense and hard. In order to obtain good Coke, caking coal, which approaches sinter coal in composition, should be selected.

In the production of coke from the small coal of the northern coal field of England, nearly every description of caking coal will make good coke; provided the duff be screened out, in which the whole, or nearly all, of the shale and mineral matter is found.

One of the most injurious mineral ingredients of coal is the common iron pyrites, the sulphur in which is not entirely removed by the operation of coking, while the oxide of iron which remains in the coke forms with the silicate a slag or sear, when the carbon is consumed. This sear, covering the grates of a locomotive furnace, for example, prevents the free access of air, wastes the fuel, which is thus to a much greater extent only converted into carbonic oxide, and diminishes the speed by arresting the rapid production of steam. Hence it has been found in practice, that a coke which leaves a white ash, although containing twice as much as another yielding oxide of iron, is much superior for locomotive purposes. Fortunately, this constituent of certain cokes, actually renders them more adapted for smelting some lead ores than others, as, for example, on the east coast of Spain, where the oxide of iron acts as a precipitant for the lead in the furnaces.

As the presence of sulphur or pyrites is thus injurious, when coke is employed for locomotives, or in remelting iron for foundry purposes, it has been proposed to remove the sulphuret of iron from the coal by mechanical means. This has been adopted in Belgium and France, and is now being carried out by Mr. Morrison, in Durham, England. The Belgium plan is similar to that employed for washing lead and zinc ores, &c., and has been for some time in operation in Vosges, where the coal is much impregnated with pyrites. M. Lechatélier, in his Report to the Minister of Public Works, in 1848 overlooking the facts we have just mentioned, adopts the following empirical rules in estimating the value of coke.

When the ash does not exceed:

	6 per cent.	the coke is good,
6 to 9	" "	the coke may be used.
9 to 12	" "	the coke is bad,
above,		the coke is worthless.

[Here follow cuts of plans adopted for washing coal.—*Editor Magazine.*]

The general results are said to be, that three workmen, during the twelve hours, can wash 11 to 15 chaldron, and the produce is in 100 parts:

Washed coals,	89
Shale,	2
Small coal,	9
	100

while the quantity of ash in the coal has been reduced nearly one half. The small coal contains 20 to 25 per cent. of ash. The cost may be calculated from the French data, as follows:

	d.
Labor,	5·1
Other charges,	1·2
Loss,	8·8
	14·6

or, about 1*s.* 2*d.* per ton of washed coals, which on a produce of 66 per cent. of coke, would make the cost 1*s.* 10*d.* per ton of coke.

To the highly important subject of coking, the structure and management of ovens, with their different forms, much space is devoted, thus furnishing facilities for obtaining complete information on the subject.

The several kinds of artificial or patent fuel are stated in full, with their composition, and the different modes of making them, with descriptions and highly finished illustrations of the furnaces and retorts for their manufacture. The substances chiefly employed in the manufacture are charcoal-dust, peat or turf, small coal, slock or brees, with refuse fat, tar, and pitch. Of the different processes, the one carried out into practice on a large scale, by a Mr. Wylom, appears to be of an extensive and important nature. The substances employed are small coal and pitch, which are moulded together by pressure into bricks. The first operation is the separation of coal tar by distillation in naphtha, dead oil and pitch. The pitch is subsequently mixed with small coals and then moulded. The naphtha is rectified, and sold as such, while the dead oil is converted into ivory black or employed for preserving timber. The tar is mixed with about an equal quantity of water which appears to facilitate the separation of the naphtha. The dead oil obtained as the second product of the distillation of the coal tar, is used for the purpose of illumination on the quays of manufactories, railway works, &c., and for preserving timber from decay when exposed to damp and water, as in railway sleepers, piers and docks. It is also employed as a solvent for pitch, in which case it makes a valuable varnish for coating wood and iron work exposed to the weather, and lastly, for the manufacture of a very superior ivory black.

In connection with the same subject, these pages furnish a description, with ample drawings, of Bessemer's process for consolidating refuse coal dust, which appears of great value. It is found that when coal or coal dust is heated up to a temperature of 500° or 600° F., it becomes softened, the bituminous portions undergoing a degree of fusion sufficient to cause the small pieces to adhere together. It is this peculiar property of partial fusion in coal that Bessemer makes use of as a means of forming, by pressure, consolidated blocks or masses of coal, possessing the characteristic properties of the coal from which they are formed, but which have the additional advantage of being in pieces of uniform size. Instead of forming the soft coal into large unwieldy masses, as usually practised in the manufacture of artificial fuel, and which require to be broken into pieces before use, producing much small coal or dust, it is made at once into small cylindrical bricks of a size well adapted to furnaces or domestic use, while the trouble and loss of breaking is prevented and a most convenient fuel obtained.

Under the title of coking in ovens we meet with a notice of Mr. Calvert's plan for the use of salt in removing sulphur. Its action in the coke oven is thus explained. The bi-sulphuret of iron contained in coal is first converted by the heat of the oven into sulphur and proto-sulphuret of iron. The latter, when salt has been added, coming in contact with the vapor of the salt, is converted into protochloride of iron, sulphuret of sodium being simultaneously formed. The protochloride is then said to be decomposed into superchloride, with the evolution of chlorine, which acting on the sulphuret of sodium, produces again chloride of sodium and chloride of sulphur; which latter is disengaged, leaving a much less quantity of sulphur in the residual coke, and that being in the harmless form of sulphuret of sodium.

In connection with this general subject, the theory and action of chimneys is investigated, and the most improved, plans of fire-grates of every description, and the numerous methods of heating apartments and dwellings, as well where the heat evolved is disseminated to surrounding bodies by radiation, as by immediate contact. Kitchen ranges, and the varied and most approved forms of stoves for burning anthracite, and the methods of heating with hot air, hot water, and steam, are all presented and examined with much detail, and accompanied with highly elegant illustrations. The particulars respecting the products obtained from the distillation of the different descriptions of fuel are of unusual interest. On the production of paraffine we make the following extract.

PARAFFINE.

Paraffine is a pure white, solid substance, resembling wax when melted in small quantities; but when cooled slowly in large masses, and quite pure, the crystalline scales become aggregated together, and it presents very much the same appearance as spermaceti ; it has no taste nor smell, and feels soft and soapy between the fingers. Paraffine melts at 112° F., and can be distilled at a higher temperature without decomposition; it burns without producing smoke, and hence is admirably adapted, either alone or mixed with other fats, to the manufacture of candles. Its specific quantity is 0.870. Its name is derived from *parum affinis*, and is indicative of the want of affinity it exhibits to most other bodies. It resists the action of all the strong acids, alkalies, chlorine and potassium.

Some varieties of coal, particularly those which afford the largest amount of illuminating gas, as the Parrot, Cannel and Boghead coals, have been latterly distilled for the sake of the naphtha and oils which they afford at a low temperature, and a patent was obtained by Mr. J. Young * for a process, by which large quantities of paraffine and paraffine oil are obtained from them.

William Brown distils coal or bituminous substances with steam, heated by passing through a coil of red-hot pipe, and obtains in this manner a large amount of paraffine. The crude products from the first distillation are submitted a second time to distillation in a similar aparatus, when a light oil, paraffine oil and paraffine, are separately collected. The light oil is purified by heating to 212° F., with from 5 to 10 per cent. of vitriol, and an equal bulk of

* See Mining Magazine, Vol. V., No. 5, November.

water, to which bichromate of potash is added in the proportion of one half of the vitriol employed. The oil is subsequently agitated with a warm solution of caustic soda.

The heavy, or paraffine oil, is purified in the same manner, and distilled again, the lighter portions of the distillate being collected separately, and the last portions added to the paraffine. Bag filters and subsequent hydraulic pressure, are employed to separate the oil from the paraffine, which is then treated at a temperature of 400° F., with $\frac{1}{20}$th to $\frac{1}{10}$th of its weight of strong vitriol, and lastly with water or a dilute solution of soda.

Various kinds of oil and paraffine were obtained by Seligne, some years ago, in France, by distilling the bituminous shale of Autun; and similar products have been extracted from the shale of Dartmoor, in the west of England. The manufacture in the latter locality has been discontinued, for reasons with which we are not acquainted, while Wiseman & Co. are successfully working at Seligne's process at Buel, near Bonn, on the Rhine. The factory at Buel produces paraffine which, at two shillings per pound, is capable of competing with wax and spermaceti, a volatile oil of sp. gr. 0.780, adapted for cleaning clothes, gloves, and used also as a solvent for resins, and for mixing with other less volatile products, to form a good burning oil of sp. gr. 0.830 for camphene lamps. This oil is sold at something less than four shillings (English) per gallon. Fixed oils are likewise obtained, which can be rendered drying, and used as paint, or burnt for the production of lampblack. Asphalt and coarse cart grease are also manufactured from the products of the distillation.

A more useful book in the arts could hardly have made its appearance at this time in this country. It embraces all the information relative to fuel and its products, and especially all the processes for the distillation and purification of the products of coal which has been obtained by practical experiments up to this day. It is illustrated with so numerous and highly finished drawings, that every process can be readily understood. This subject is comparatively a new one in this country, and destined to absorb a large share of attention. We know of no work in which such extensive and recent information relating thereto, and also to every thing connected with coal gas, can be found so clearly stated or fully illustrated. On another occasion other topics of this work will be noticed in these pages.

But we cannot close this article without a notice of some of the methods for the distillation and purification of some of the products of cannel coal. We are happy to know that Breckenridge's coal has already become an article of demand for the same use.

COAL-TAR NAPHTHA.

The processes employed in preparing naphtha and pitch-oil from tar, have already been alluded to in describing the manufacture of patent fuel, but no mention was there made of the purification to which the crude naphtha is submitted. The tar is distilled with about 1-5th of its bulk of water, or steam is blown into it as long as naphtha passes over with the condensed water; the former process yielding the best, the latter the most abundant product. In Scotland, where much cannel coal is distilled, the average yield of naphtha is about 10 per cent. of the tar used; from Newcastle coal-tar not more than 5 per cent. is obtained, while some cannel coal-tar is said to yield as much as 20 per cent. of crude naphtha. The crude naphtha is mixed in a large leaden dish, capable of holding 500 gallons, with a small quantity of vitriol, with which it is well agitated, and which removes a considerable

quantity of basic substances, ammonia, and water. This first portion of vitriol having been removed by a plug-hole at the bottom of the vessel, a larger quantity of vitriol, varying from 4 to 5 per cent. of the crude naphtha, is added, which not only removes the remainder of the basic substances, but likewise chars or converts into resins those of the neutral oils which absorb oxygen, and turn brown when exposed to air and sun-light. The portions of the naphtha which are thus affected by oxidizing agents are those which boil between 140° and 200° C. (284° and 392° F.), cumole and cymole, according to the foregoing table, and also the allicaceous product boiling below 80° C. (176° F.) Much heat is generated by constantly stirring the vitriol during several hours with the naphtha, and sulphurous acid is evolved. The whole is then allowed to stand for some time, when the vitriol containing the altered hydrocarbons settles to the bottom of the tank, and is drawn off. The naphtha is then well washed with successive portions of water, and lastly with a dilute solution of caustic soda, containing milk of lime, to remove the last portions of the acid and any acid products that also exist in the naphtha. The product thus obtained is now pumped into an iron still, and steam is blown through it, which carries over the greater portion of the naphtha. Both steam and naphtha vapor are condensed by an ordinary worm, and separate easily from each other, in consequence of their different gravities. A considerable quantity of naphthaline crystallizes from the last portions which pass over. The rectified naphtha should not be exposed to light for some time after it leaves the still, or the small portions of water mechanically mixed with it will not separate. In the dark, however, it soon becomes perfectly clear, and should then, if properly purified, stand the test of exposure to the sun's rays without acquiring color. Coffey's still, described at page 291, appears admirably adapted for the distillation both of tar and naphtha, and has been used for that purpose in some manufactories, the trays and pipes being all constructed of iron instead of copper.

Crude naphtha distilled without water begins to boil at about 100° C. (212° F.) and continues to pass over liquid until the temperature reaches 200° C. (392°F.) when solid products begin to make their appearance. The rectified naphtha of commerce begins to boil at about 90° C. (194° F.), and about one eighth of the liquid passes over before the temperature rises to 100° C (212° F.); distillation continues up to about 160° C. (320° F.), when the retort generally becomes dry. The specific gravity of rectified naphtha ranges about .86, that of the different hydrocarbons of which it is composed varying from .85 to .87. If it be above .875, it is an indication of naphthaline or some heavy oils boiling above 200° C. (392° F.) being present. The most volatile portions of the naphtha, however, have a higher specific gravity than the less volatile, so that specific gravity cannot be taken as a test of volatility, which can only be estimated by the temperature at which the greater portion of the naphtha is converted into vapor.

Mansfield has obtained a patent for separating the different hydrocarbons from each other, by so arranging a number of different still heads or partial condensers to a single still, that each product shall be collected apart at about the temperature at which it boils. The separation is not completed in any single distillation, as the hydrocarbons are so closely allied that their vapors diffuse most easily into each other. By repeating the process of distillation, they can, however, be so far separated as to exhibit marked differences of physical character, and become applicable to different purposes.

Alliole, the most volatile of these bodies, is obtained by distilling crude naphtha, and collecting all that leaves the still in the first distillation, before the boiling temperature reaches 90° C. (194° F.), and on the second distillation all below 80° C. (176° F.); or, if a condensing head be employed with the still, by collecting all that passes before the temperature of the head has passed 60° C. (140° F.) This substance combines with, or is altered by, vitriol, and hence it is better obtained from the crude naphtha, and afterwards purified by agitation with dilute sulphuric or hydrochloric acid, and

redistillation. It boils when nearly freed from benzole, at a temperature of from 65° to 70° C. (149°—158° F.), and possesses an alliaceous odor somewhat resembling sulphuret of carbon. It is an excellent solvent, alone or mixed with an equal proportion of pyroxylic spirit, of caoutchouc, gutta-percha, shellac, and many resins.

Benzole or benzine $C_{12}H_6$, the substance first obtained by Mitscherlich among the products from the dry distillation of benzoate of lime, forms a considerable and probably the most valuable portion of coal-tar naphtha. It may be separated sufficiently pure for many purposes by distilling rectified naphtha in a still with a head enclosed in a vessel of water, and so constructed as to allow all the vapors that have higher condensing points than 100° C. (212° F.) to fall back into the still. The naphtha being heated in the still by direct fire, the vapors ascending to the head soon cause the water to boil; alliole, benzole, and small quantities of the next most volatile hydrocarbon, toluole, pass over, while the less volatile cumole and cymole vapors are condensed and returned to the still. The alliole and toluole may be separated in great measure from the benzole by collecting the first and last portions which pass over in a second distillation. If still purer benzole is required, the middle product from the second distilation is treated with one half pound of vitriol, and about an ounce of nitrate of soda or potash, to every gallon, which destroys the alliole, and oxidizes any portion of the hydrocarbons which turn brown on exposure. A little nitric acid may also be used, which communicates a pleasant odor to the product by forming some nitro-benzole. The acid, and the substances separated by it, having been allowed to subside, the benzole is thoroughly washed with water. The product should then begin to boil at 80° C. (176° F.), and be entirely volatilized at 100° C. (212° F). If required perfectly pure, it is again treated with vitriol and some oxidizing agent, washed with water and lime-water, again distilled, collecting those portions only which pass over between 80° and 85° C. (176°—185° F.) and lastly submitted to a temperature some degrees below the melting point of ice, by a freezing mixture, when the greater part will congeal to a mass of crystals; these are submitted to powerful pressure at the temperature of 0° C. (32° F.), and the solid portion then melted, and, if necessary, again put through the same process of congelation and pressure. The product should then be entirely converted into vapor between 80° and 82° C. (176°—179°.6. F). It produces a state of intoxication, when inhaled, similar to that produced by ether, and may be used in many cases as a substitute for that substance. Pure benzole dissolves iodine, wax, quinine, fat, and volatile oils. When acurrent of air is passed through it, so much of its vapor is taken up as to afford a very luminous flame when ignited, and the cruder kinds of benzole are proposed by the patentee to be used in this manner in the lamps and burners described at page 510. The less pure benzole, which contains alliole and toluole, may also be used as a solvent in preparing varnishes, all the substances mentioned as soluble in alliole being dissolved also by benzole. When gutta-percha is dissolved in benzole, and the solution spread on a smooth surface, the benzole speedily evaporates, leaving a tough film, which may be peeled off, and affords an artificial membrane applicable to many useful purposes; and when applied to the surface of the human body, an artificial skin is produced.

Nitrobenzole.—Benzole is not destroyed by concentrated oil of vitriol, but is converted by fuming nitric acid, sp. gr. 1.5, into *nitro-benzole* ($C_{12}H_5NO_4$), —a substance in which one equivalent of the hydrogen of the benzole is substituted by the peroxide of nitrogen (NO_4). Nitric acid is placed in a capacious glass vessel, surrounded by cold water, and the benzole in about an equal quantity is added to it, until two layers of liquid begin to appear; the vessel is then removed from the cold water and gently warmed until the two layers have united to a clear solution; the whole is then thrown into six times its bulk of cold water, when a heavy yellow or red oil sinks to the bottom. This is the nitrobenzole, which is repeatedly washed with water, and may be distilled without

decomposition at a temperature below 220° C. (428° F). This substance boils at about 210° C. (410° F.), possesses a very agreeable odor of bitter almond oil, and is useful as a perfume, especially applicable to soap, and in small quantity to confectionary.

Toluole ($C_{14}H_8$) is obtained by collecting the last portions of the distillate from crude benzole, and purifying it with oil of vitriol, which has no effect upon it, while it destroys the hydrocarbons having higher boiling points. The portions of naphtha boiling from 90° to 110° C. consists principally of this substance, which, when pure, boils at about 110° C. (230° F.) and is capable of conversion, like benzole, into an aromatic oil by nitric acid.

Camphole.—The oils boiling at 140° and 170° C. (284°—338° F.), called respectively cumole and cymole in the table, are collected together and called collectively *camphole* by Mansfield. These oils no longer take fire when an ignited match is plunged into them, and they are thus distinguished from the more volatile toluole and benzole; they continue to distil over from the crude naphtha until the boiling point in the still has reached 190° or 200° C. (374°—392° F.) The specific gravity of crude camphole ranges from .88, to .98, and the less volatile portions frequently contain naphthaline, which raises their specific gravity. Camphole is strongly acted on by sulphuric acid, which converts the cumole into a viscid resinous substance; nitric acid converts it into a heavy oil, or into acid substances; the oil is rectified by repeated distillation, separating each time the first and last portions from the great bulk of the product, and then treating it with a strong solution of caustic alkali, to remove creosote and acid bodies, and subsequently with a dilute acid. This substance, either alone or mixed with pyroxylic spirit, is applicable for burning in lamps, or for dissolving resins as a substitute for oil of turpentine.

Pitch or Dead Oil.—The residue in the still after the whole of the naphtha has been separated is called distilled tar. It is sold as such to a considerable extent, and employed for coating ships and painting woodwork that is to be exposed to the weather. The greater part, however, is again submitted to distillation without water, at a high temperature, in strong wrought-iron vessels exposed to the direct action of the fire. The product which comes over in this distillation varies as the temperature in the still rises; at first it exhibits a light yellowish-green color, and a remarkable opalescence, which increases by exposure to air and light, until after some time it becomes bottle-green by reflected, and dark brown or red by transmitted light. The color becomes darker and the consistence more viscid as distillation proceeds, and the last portions are often semi-solid. The odor which this oil possesses is peculiar and indescribable, and no success has as yet attended the attempts to remove entirely the color and smell by repeated distillation or other means. Mansfield obtains a substance from this oil which he calls *mortuole*, by digesting the dead oil with strong alkaline ley, and subsequently with acid, and distilling. A nearly colorless product is said to be obtained by repeating these processes.

JOURNAL OF MINING LAWS AND REGULATIONS.

BATTIN'S COAL BREAKER.

U. S. Circuit Court, 1.

In the case of *Joseph and Samuel Battin*, vs. *Samuel Silliman, et al.*, a motion for an injunction to restrain defendants from an alleged infringement of what is known as Battin's patent coal breaker, the following opinion was delivered by Judge Grier:—

"The remedy by injunction in patent cases is given by courts of equity, on account of the insufficiency of that given by a court of law. It is in its na-

ture preventive, where irreparable mischiefs are apprehended, or when the patentee is likely to be vexed by litigation and a multiplicity of suits against stubborn pirates of his invention. The Circuit Courts of the United States have original jurisdiction as Courts of Chancery in all patent cases. They do not act merely as auxiliary to courts of law, and many therefore render a final decree on a patent whose validity is contested without sending the parties in law to try their rights.

It is no reflection on juries or trial by jury to say, that many disputes about the originality and infringement of patents depending upon complex mathematical calculations, upon a knowledge of the principles of chemical science, and of mechanical philosophy, cannot be satisfactorily decided by the verdict of twelve men, a majority, if not all of whom, have no knowledge or experience on the subjects they are called to decide on. But while Courts of Equity will, in some cases, decide such questions on final hearing, without the assistance of courts of law, it does not follow that in every motion for preliminary injunction, the Court will try and determine the whole case on ex-parte affidavits, on five days' notice, like a Court of "*pied poudre.*"

In cases of waste, purpresture and nuisance, where the mischief which may be done by their continuance till final hearing, may be irreparable; or where the injury or loss to the defendant by this interposition may not be of importance, or the delay in exercising his rights could be easily compensated; such preliminary interference may be necessary to the ends of justice, even where the equity of the bill is denied by the defendant. In the case of infringements of patents, such can seldom be the case, and such preliminary intervention can only be invoked in case of wanton and stubborn persistence in pirating an invention, the title to which has been clearly established either by trial at law, or by long and peaceable possession. Hence we have refused to grant a preliminary injunction where the defendant denies on oath the originality of the invention or the infringement of the patent, leaving the decision of the question till final hearing. It must be a very strong case indeed, either of impending mischief to the complainant, or where the Court, by having the machines or models before them, can see clearly that the defence set up is a mistake or a mere pretence, that the Court will thus summarily interfere by granting execution before final judgment, where the defendant alleges under oath a valid defence, and denies the equity of the plaintiff.

There are cases, also, in which this preliminary injunction would cause irreparable injury to the defendant, with no corresponding benefit to the patentee.

Where the profits from a patented invention arise from a monopoly of the sale of the machine, medicine, or composition invented, and the competition of the defendant may be highly injurious to the established legal rights of the patentee, it may be a very proper exercise of the discretion of the Chancellor to restrain the defendant from infringing till he has established his right, if he pretends to have any. But the case is very different where the supposed infringement consists in the cause of some improvement in expensive machinery, which has been adopted in good faith, by a defendant, and where the profit of the patentee consists, not in the monopoly of selling his machine, but in the price of licenses given to others to use it. In such a case it is the interest of the patentee that all persons should use his improvement, provided they pay him his fee for a license. The injury to him is not in using his invention, but in not paying for such use. It would be an abuse of the discretion of the Court to stop a mill or furnace because it may have used some patented improvement in its machinery. It may ruin the defendant, without any corresponding benefit whatever to the patentee. The only injury to him is the nonpayment of his license, which will be remedied by the final decree of the Court, if the defendant shall be found a wrong doer. The patent in this case is for certain rollers used in the machinery for breaking and screening anthracite coal; they form but a small, though important part of the combined machinery for the purpose. The steam engine and other apparatus necessary

to the operation costs many thousands of dollars. The patentee has a fixed price for the use of his invention, one cent per ton. As between these parties alone, it is the interest of the complainant, that the respondent should continue to use his invention provided he pays the cent per ton. An injunction, by stopping the business of the defendant, may be ruinous to him. The only use to complainant would be an unjust one. It would deliver the defendant over to him with a rope round his neck, and compel him to accept any terms dictated by the patentee. The defendant has sworn to his belief that he has a good and sufficient defence. Witnesses have sworn that the patentee is not the original and first inventor of the machine. The defendant has a right to a hearing before he is condemned as a pirate or infringer of the complainant's rights. Yet the granting of this injunction would compel him to accept the complainant's terms, and buy his peace without a hearing. And not only so, but it is alleged, and not denied, that some two hundred others would be compelled to do the same.

"It seems to me," says Lord Cottenham, in Neilson vs. Thompson, "that stopping the works by injunction, under these circumstances, is just inverting the purpose for which an injunction is used. An injunction is used for preventing mischief; this would be using the injunction for the purpose of creating a mischief—because the plaintiff cannot possibly be injured. All that he asks, all that he demands, all that he ever expects, is one shilling per ton (and in this case, a cent per ton). The injunction would be extremely prejudicial to the defendants, and do no possible good to the plaintiff, for the purpose for which it may be used. It may, by operating as a pressure upon the defendant, produce a benefit. But that is not the object of the writ. The object of the Court is to preserve to each party the benefit he is entitled to, until the question of right is tried, and that may entirely be secured by the defendant's undertaking to keep an account. If the plaintiff is entitled, the Court will have an opportunity of putting him precisely in the position he would have stood in if this question had not arisen." But it is contended that the Court are bound to give the plaintiff the benefit of this interlocutory injunction, whatever use he may be disposed to make of it; because there has been a verdict of a jury establishing the validity of his patent, and a peaceable possession of the rights conferred by it.

Admitting the court would be justified, for these reasons, to grant this motion, without any exercise of discretion founded on the reasons we have given, we do not think that these assertions are supported by the evidence. It is true there has been a verdict on a former trial between other parties. But that verdict was set aside by the court as contrary to law, and it moreover appears, that the defence now offered to the validity of the patent, was not before the jury, nor passed upon by them. They were instructed by the court to assess the damages, without reference to any other question. In a subsequent trial, the same court decided against the validity of the patent on questions of law, which were afterwards reversed by the Supreme Court. But in none of these trials did either the court or jury pass upon the defence, as to the originality of the plaintiff's invention, on the facts now submitted. The verdicts in the cases can therefore have neither a technical nor moral effect in the decision of the present motion.

Neither can the evidence of long possession benefit the plaintiff; for it has not existed. On the contrary, after the decision of the Circuit Court against the validity of the plaintiff's patent, those who had previously agreed to pay the plaintiff for the use of his invention, have ceased to do so, and many others, acting in good faith, have used the invention in their coal-breaking machines, in hostility and adverse to the plaintiff's claims. It has been admitted on the argument, that some two hundred machines are in use by persons who resist the claim of the patentee.

In every view I can take of the case, I think the granting of this motion would be an injudicious use of the discretion of the court, and wrong to the defendants, who, from any thing that appears, may believe that they have an

honest defence to this action, and are, therefore, entitled to full and final hearing before they are condemned.

If this motion were granted, they would be compelled to submit without a trial of their rights, which would be contrary to the first principles of practice, and an act of sheer tyranny in the Court. Without intimating any opinion as to the validity of this patent, or the truth of the defence, the Court must refuse this motion, with costs, and order an issue between the parties as to the validity of this patent, to be tried before a jury on the first Monday of April next. Defendant ordered to keep an account.

COMMERCIAL ASPECT OF THE MINING INTEREST.

New York, Nov. 20th.

The month now closing has been one of considerable fluctuation in the prices of all securities. Money tightened up considerably at its commencement; but, at its close, has become again easy, with an accumulating fund of specie at the banks.

The banks of France and England both raised their rates, the former to six per cent. and the latter to six for dates of mercantile paper not longer than 60 days, and to seven for dates from 60 to 90 days, beyond which no paper is discounted. The news of this advance in the rate of discount abroad had an ill effect in our market for stocks, in which one of the most senseless panics on record took place;—out of dread that the bank of France might stop paying specie, an event which would rather tend to keep our gold at home than hasten it abroad. The wants of France for grain are immense, and she cannot have from us, in any large quantities, breadstuffs and gold at the same time, from the very obvious circumstance, that she could not pay for both, *her* paper money not being available out of her own kingdom. Since then, however, France has got supplies of gold from Australia, via. England, which seems to have sufficed for her wants, as the last advices indicate. And the receipts of gold from her colonies have supplied her also with sufficiency to supply the demand she has had to sustain. Our foreign demand for specie has ceased, the pressure of cotton and breadstuffs for shipment being unusually large, and supplying an amount of exchange on Europe, which has reduced rates to points much below what gold can be shipped profitably at, viz: 108½ c. 106 for bills on England, and 5. 21¼ c. 5. 22½ for those on Paris. The lower rates are for produce bills, and the higher for bankers. It is unusual to witness at the same time a rising market in Liverpool, both for cotton and breadstuffs. We do so, however, now; the stocks of cotton in market, and in spinners, hands is small, and the demand is increasing, notwithstanding the war, which is not so exhaustive as was thought would be the case. Our cotton crop this year will be one of the largest; yet it will all be wanted, and supplies are coming fresh forward, and being shipped as fast.

The rates for the discount of mercantile paper, have risen and fallen since we went last to press. The rates were, early in the month, 10 to 12, and

afterwards 12 per cent. for a time, for the best kind of bills; now they have fallen to 9 and 10 per cent. for the same description, and over 12 per cent. for second class names, and the market closes with a downward tendency. Specie is being accumulated in the banks, which consequently no longer contract their financial accommodation, but on the contrary were more disposed to expand, though cautiously. The heavy payments of the fall months are now over, and as the supply is larger with a lessened demand, the prospects of the money market are favorable.

The stock market has, during the last week, taken a revived tone from its previous heavy depression, and is moving upward. Of mining stocks, coal stocks seem the only eligible stocks for exchange. Copper stocks are very quiet. The mines of Tennessee, at Duck Town, though good, are not being actively worked. Those of Lake Superior are also dormant, except for the two—Minnesota and Cliff—a small exception from the depression which seems to mark the whole district. Agents for the sale of copper mines are still in London, seeking customers, without immediate result.

The Stockholders of the Potomac Copper Company assembled on the 21st inst., when the President, Alexander Hamilton, making extraordinary charges against its previous managers, a committee of examination was appointed, to report to a subsequent meeting. The members of it appointed were Messrs. L. Underhill, S. S. Leeds, and Mr. Condit, of the firm of Messrs. Condit & Jenkins.

The Coal Companies are the only ones whose stocks are active in the market. Even the Boston Copper Mining and stock market is inactive. At the New York Mining board, Gardiner Copper shares have been selling at ⅝ to ⅞ per cent. The friends of North Carolina Copper and McCulloch Gold and Copper Mines are as sanguine as ever.

Reading stock is buoyant at 91½ to 91⅝, with prospect of a heavy dividend in January. Cumberland Coal stock is moving up. It fell as low as 21⅝, but is now 25, with good prospects for an advance to 30. Negotiations are going forward for the sale of a portion of the property. Notwithstanding the decline, prices of stocks are higher now than in October. Pennsylvania Coal stock is steady; and Delaware and Hudson Canal, from the strong and abiding faith of its stockholders, is without change, there being few transactions in it.

The old Wheatly, Brookdale, and Phœnix Mines in Pennsylvania have recently been united in interest, and their several Companies consolidated into the Pennsylvania Head Company. It is organized into a body corporate, under the general act of the State of Pennsylvania, relating to mining. The individual liability of the stockholders, is now limited to a few cases pointed out in the act, such as debts due to miners and laborers, and for machinery, provisions and merchandise, furnished to the Company. The capital stock is $500,000, divided into 100,000 shares of five dollars each. The mineral rights held by the Company comprise a number of tracts containing in all 400 acres, 330 of which are held under favorable leases; three-fourths of the mineral right on the remaining 70 acres are owned *in fee* by the Company, and the other fourth by lease.

COALS AND COLLIERIES.

ANTHRACITE COAL TRADE FOR 1855.

	Tons.
Shipments by Reading Railroad, to November 15th,	2,138,666 09
" Schuylkill Canal,	1,014,679 02
Total.	3,153,345 11
To same time last year,	2,745,652 10
Increase thus far in 1855,	407,593 01

LEHIGH COAL SHIPMENTS TO NOV. 10TH.

Summit Mines,	300,277 05
East Lehigh,	84,648 02
Room Run Mine	73,580 19
Beaver Meadow,	88,858 11
Spring Mountain Coal,	168,878 14
Colerain Coal,	91,595 00
Stafford Coal,	9,789 01
East Sugar Loaf Company,	48,854 01
New York and Lehigh Company,	86,641 00
French American Coal Company,	7,257 05
A. Lathrop's Pea Coal,	2,844 10
Beaver Meadow Pea Coal,	465 01
Hazelton Coal Company,	151,713 03
Cranberry Coal Company,	78,462 05
Diamond Coal Company,	81,822 00
Buck Mountain Coal,	80,488 17
Wilkesbarre Coal Company,	45,225 15
Wyoming Company,	1,614 17
Total,	1,205,069 06
Last year,	1,136,709 16
Increase in 1855, so far,	67,859 10

MARYLAND COAL TRADE.

The Shipments from the Cumberland region to Nov. 3d were 566,496 16 tons, of which 252,674 15 tons were shipped from the Westernport region. The shipments last year were about the same.

SOME FACTS RESPECTING THE PRICE OF COAL.

We find in the Pottsville Journal a statement of some facts connected with its production which must have a very important influence on the price of coal. It would not be surprising to us if the prices of coal should not decline, but rather advance for some years. In the first place, experience has shown that the opening of new avenues to market does not reduce the price. New parties coming into the field never cut down prices when there is a good business for all. In the next place, the increase of the demand at present keeps pace with the increased supply. Indeed, the opening of one new avenue a year by which to send coal to market, will not affect the price. The maximum for a single railroad track, especially with any passenger and general freight business, is below 400,000 tons as the amount which can be transported over it in a year. The average annual increase in the shipments from the Anthracite region during the last five years, over the preceding five, has been nearly 400,000 tons, and prices advancing. Some other circumstances are worthy

of attention when speaking of the nominal price. The vast ncrease of the precious metals has cheapened their intrinsic value, or advanced all the necessities of life. Congress has also adulterated a portion of the currency, which has not been without its influence. Let us turn to the local facts presented in the mining region; says the Journal:—

"But to show the reason why the present prices of Coal will not pay, we have only to state a few facts.

First, the price of labor is full one-third higher now than formerly when the prices of Coal were equally as high as at present. It would be impossible for men to live at the present rates of provisions, under the old low wages of ruinous coal trade prices. Our miners and laborers must live, and as flour and provisions cannot be bought at less than one-third higher than they were some years ago when Coal was low, their wages must rate in comparison.

In the next place, a much larger amount of iron is now made use of in and about the mines, than formerly: and this article being comparatively high, makes a large figure per ton in the price of producing coal. The fact that iron is not in reality higher now than it has been, does not alter the case. When timber was plentiful and cheap, this item of expense was but trifling in comparison, as the operators then used wooden instead of iron rails, and therefore it is one reason why Coal cannot be mined and sold at a profit, as cheap as formerly.

"Another large item of expense, which is likely to escape the notice of the buyer, is *powder*. This article, of which enormous quantities are used in the mining of Coal, has risen within the last three months over one hundred per cent. It could be bought during other seasons for two dollars per keg, but now it is from four dollars and fifty cents, to five dollars per keg. We have known a pair of miners, even in breast work, use two kegs of powder per week, blasting coal; and in driving gangways and tunnels, the quantity is much augmented; but that quantity of powder is above the average amount used; were it not, the price of the powder alone would be almost equal to the worth of the Coal. Probably one keg of powder per month would be about the quantity used on an average—certainly it would not be much less, and this amount calculated into dollars and cents, where several hundred miners are at work, would be no small sum in the year.

"Those three items—wages, iron and powder—each being much higher than formerly under low prices, will make not less than fifty cents per ton of difference in the production of Coal over former years. But those are not the only ones, for there are others that bear heavy on the operators this season, which were not so severely felt during other seasons. The mines are continually being worked deeper, and as they increase in depth, the cost of hoisting Coal and pumping water increases in proportion.

"The present season has been an unusual wet one, and the operators, not only of the Schuylkill, but also of the Lehigh and the Wyoming Regions, have felt the cost of pumping water no small item. Indeed many of our best mines, in each of the three regions, have been "drowned out" for weeks together, so as to be unable to produce Coal at any price; and *all* whose mines lie below water level, have been seriously injured by this particular item of cost.

"Another of the increasing expenses in the mining of Coal, is the scarcity of timber, which is continually growing less, and formerly could be supplied at less than half the price.

"The last reason, which is not the least, why the present prices will not pay the operator, is the high rates charged by our carrying companies. The consumers undoubtedly feel that they are paying high enough for their Coal, and the fact is that they are, but the Transporting Companies take all the profits, leaving none for the producers who supply them. A fair division of those profits would be but just. In this part of the Coal Region, a reduction on the part of the Transporting Companies of 50 cents per ton could well be made, and in justice to all parties ought to be made. In fact Coal cannot be mined,

with a few exceptions, by our operators, at present prices; and as the only alternation, many of them have been forced to suspend, and others only continue for the purpose of keeping things together. Those who have many hundreds of families dependent on their operations for support, cannot well suspend without great loss and inconvenience to themselves and distress to their dependents. When the hands belonging to a Colliery have been dispersed, as they cannot lie idle, the difficulties of collecting a *set* again, can only be fully realized by experience. Yet with these objections to suspension, many have already done so, and others with much reluctance are preparing to suspend, as under either alternative there must be a loss. But to mine their best Coal, and exhaust their Collieries, even at a loss, when, under other circumstances, it might be made to pay a fair interest on the capital invested, and return some remuneration for their labor and time, is as much against their desires as their pockets.

"But the aim of our present remarks is to show the reasons why the present prices of Coal are as low in comparison as they ever have been, and not to attack individuals or companies; and having done so, we will conclude the present article, by adding that, however seriously the low prices of Coal are felt in this or the First Region, the operators of the Second and Third Regions experience the same difficulties, if any thing, still more severely—several of them having suspended shipments, or curtailed their operations in consequence."

NEW AVENUES FOR THE TRANSPORTATION OF COAL.

The following proposed railroads are intended to furnish increased facilities for transporting coal from the anthracite region to New York and Philadelphia. We publish them as requested, presuming the statements of distances, &c., are most reliable data. Some of the districts in England, which mine the largest amounts of coal, send very little to London. Their facilities for transporting it to the beds of iron ore, secure a large consumption.

CIRCULAR: *The Commissioners of the Allentown Railroad to the Coal Operators, and to all other Business Men of the Schuylkill Coal Region:*

We invite your attention to the proposed Allentown railroad, with the view of obtaining your aid in the construction of this new avenue, which we propose to open for the transportation of Anthracite Coal—the staple product of your country—to the Easton markets, by a continuous railroad route, shorter and cheaper than any other; so that coal, loaded at your mines, may within *twelve hours* be discharged into vessels moored in the port of New York, at a cost for transit of *two dollars per ton.*

The large expenditures lately made in railroads, leading from the Mauch Chunk and Wilkesbarre coal fields direct to the city of New York without transhipment—expenditures, to a large extent, made by parties already interested or very well acquainted in your coal region—show that the transportation of anthracite coal to northern markets will soon be *revolutionized* by the direct railroads; and we presume no argument is needed with you, to demonstrate, that without similar advantages indirect communication by rail with the harbor of New York, it will be *literally impossible* for the Pottsville coal region to compete successfully with more favorable localities.

The route of the present carriers is too long, their charges too high, and the capital invested in them too heavy, ever to allow them to place your region in position to compete successfully in northern markets, with the well constructed railroads about to be opened, for the cheap and speedy transit of anthracite coal *direct* from the Mauch Chunk and Wilkesbarre mines to the waters of New York, occupying only half a day between the mines and the ship. You must have a new outlet, *by rail*, direct to New York, to enable you to maintain your position in the coal trade—and that outlet we now offer you.

The distances from Pottsville to New York harbor, show that only 48 miles of new railway require to be constructed, and they will be as follows, to wit:

TO BE CONSTRUCTED:

	Miles.	
Pottsville to Schuylkill Haven,	4	
Schuylkill Haven to Auburn,	6	
Auburn to Port Clinton,	5	
Port Clinton to Allentown,	33	
	—	48

NOW FINISHED AND IN OPERATION:

Allentown to Easton, by the Lehigh Valley Railroad, (now in operation),	17
Easton to Elizabethport on N. Y. harbor, by the Central R. R. of N. Jersey, (now in operation),	63
Total distance from Pottsville to the shipping depot, in N. Y. harbor,	128

This direct railroad route from the Schuylkill coal mines, will not only deliver its coal into vessels floating in New York harbor, within sight of the city, but also gives a communication by rail from Elizabethtown to Jersey city, a suburb of New York ; and this route has already been used with effect by the Mauch Chunk operators, to run coal directly from the mines into the city of Newark, *and reduce the price of coal in that place;* this small but significant fact is but the beginning of the end—this newly opened direct railroad, as yet inadequately equipped, has already reduced the price of coal at Newark, on the very confines of New York city—and it does this, *in competition* with the same article forwarded from your county through the existing carriers.

Upon our new York coal line *via* Allentown, there will be no grades ascending against the coal higher than 22 feet per mile, and these occur only in two places, of eight and three miles in length, upon the Central railroad of New Jersey—these adverse grades form only 9 per cent. of the whole distance from Pottsville (all the rest being nearly level or actually descending) and we are advised that with an adequate business these ascending grades can be worked with assistant power, *so as in fact to add but eleven cents to a ton to the cost of carriage over that of a railroad level, throughout the whole distance of* 128 *miles from Pottsville.*

The charges on coal which the company have been advised to make, and which we have no reason to believe will be exceeded—whenever the magnitude of the business will justify *minimum charges*—will not, we suppose, exceed *two dollars per ton* from Pottsville to New York harbor, 128 miles; but this matter must rest with the Board of Directors, in which body we hope you will be represented.

We propose at present to undertake the construction of that portion of our New York coal line between Auburn and Allentown, relying upon the lateral railroad interest, *to wit:*—The Mount Carbon railroad—the Mine Hill and Schuylkill Haven railroad—the Mount Carbon and Port Carbon railroad—the Mill Creek railroad—and the Schuylkill Valley railroad—to construct the 10 miles from Pottsville, which, in addition to the contemplated connection with the Little Schuylkill, is all that is required in the Valley of the Schuylkill, to connect the whole of the coal mines with the railroad we have now in hand.

The financial power of these five lateral railroad corporations, or any one of them, is ample to build the 10 miles of railroad required between Pottsville and Auburn; and as it is decidedly their interest—*as lateral railroads*—to promote their own business, by adding to the number of principal carriers to distant markets, there can hardly be a doubt that favorable action from them or some of them, may be timely had;—should it be declined, however, the people and the interests that will then have been embarked in our New York coal line, will be strong enough to cover the ground.

We have hitherto considered this subject only as looking to a coal railroad to New York city, that being the most important to you—but our engineers

assure us, that in connection with another enterprise, we shall be able to form an alternative coal line to Philadelphia *as short as the Reading railroad, and not, like it, overloaded with a capital that forbids moderate charges.*

The powerful interests that now are or soon will be engaged in the construction of our new coal railroad, will insure its completion in due time—probably without the aid of the coal region; nevertheless, a moderate degree of assistance from that quarter, will unquestionably promote the object.

We need hardly urge upon you what you often must have felt—the great importance to the coal-producing interest, of a representation at the directors' board of the carrying companies—if you now enjoyed that privilege, you would not probably be suffering from exactions beyond your control—*but this representation can only exist where there is an interest to be represented*, and we therefore offer and invite you to take that interest in the important work to which we have called your attention, and in which you, more than any others, are the most deeply concerned in your business relations.

We are assured by our engineers that the work we have in hand will only cost about $2,000,000 (two millions), with an equipment adequate to commence business, but which must be largely extended as that business offers.

Referring you to the reports of our engineers, which have been extensively circulated, we will close this communication by a comparison of the distances between Pottsville and New York, over which the large and increasing travel between your coal region and the great commercial emporium of our country will necessarily pass:

POTTSVILLE TO NEW YORK VIA PHILADELPHIA:

		Miles.
Pottsville to Philadelphia depot,	93	
Philadelphia depot to Camden,	2	
Camden to New York,	89	
Total,	—	184

POTTSVILLE TO NEW YORK VIA ALLENTOWN.

Pottsville to Allentown,	48	
Allentown to Easton,	17	
Easton to Elizabethport,	63	
Elizabethport to New York,	12	
Total,	—	140
Difference in favor of the Allentown route,		44

Instead of leaving Pottsville (as is now done) at 7½ A. M., and not reaching New York before 6½ P. M.—*eleven hours*—we will undertake through our new route *via* Allentown, to run passengers from Pottsville to New York in *five hours*—thus saving *six hours* in time of transit to the cities of New York, Boston, and all northward points.

The travel between Pottsville and all points of the western country will also be greatly facilitated, as this will probably be the route taken by the quickest trains from New York *westward.*

The construction of this road into a remarkably fine agricultural country, will very favorably extend the area of supply at the command of the coal region, and it will also open immense beds of the finest iron ore, from which blast furnaces in your region may be economically supplied, and to which your coal region will furnish the fuel.

CHRISTIAN PRETZ.

Pottsville, Nov. 9th, 1855.

LACKAWANNA AND BLOOMSBURG RAILROAD.

(For the Mining Magazine.)

The Wyoming and Lackawanna Valleys, in Luzerne Co., Penn., constitute what is called on the Geological maps the Northern Anthracite Coal Field. The coals of that field, inexhaustible in quantity and of the very best varieties of Anthracite, are more favorably situated for cheap mining and ready transpor-

tation to this market, than those of either the middle or southern coal fields. Hitherto the works of the Delaware and Hudson Canal Company, which touch only the northern extremity of this field, have been the only channel for its coals to reach the City of New York; but the Lackawanna and Western Railroad, now progressing rapidly to completion, and certainly to be opened during the present year, will supply a direct communication by a railroad of large capacity and of unbroken gauge. This road, connecting at its eastern terminus with the Central Road of New Jersey at Hampton, enters the valley of the Lackawanna at Scranton, eight miles above the point where that stream empties itself into the Susquehanna. From the confluence of those rivers the valley assumes the name of Wyoming, and stretches down the Susquehanna sixteen miles. The two valleys of Wyoming and Lackawanna are without any topographical separation. They flow into each other as naturally and as smoothly as their waters, and constitute, in fact, but one great valley. An unbroken coal formation extends throughout their entire length. A Railroad Company, with the name that heads this article, has been incorporated and organized, and is now engaged in constructing a railroad from Scranton down the Lackawanna and Susquehanna to Bloomsburg, in Columbia County, where it intersects the Catawissa, Williamsport and Elmira Railroad, now in successful operation. For about 25 miles from Scranton downward, the road runs over a continuous coal bed, as well as through a fertile agricultural district, for it is one of the striking peculiarities of that Northern coal field, that it is a fine farming as well as mineral region. Crops grow luxuriantly on the surface, while the purest anthracite is taken from beneath. This Road will be in effect an *extension* of the Lackawanna and Western Railroad. The latter *crosses* the coal-field,—the former traverses its entire length. They are not rival Roads, but supplementary and auxiliary. Each will help the other, and by means of both, that whole coal-field will be brought within a few hours' ride of the city of New York. From any of its numerous collieries, coal can be delivered in this city the same day they are mined. These two Roads will develope the whole of that great coal-field, and secure its abundant fruits to New York for all time.

After the Lackawanna and Bloomsburg Road leaves Wyoming Valley, it very soon enters the rich agricultural, limestone and iron ore lands of Columbia County, and will supply the numerous iron manufactories along that part of its route with the fuel which constitutes one of their great staples. No Road 56 miles in length could be projected with fairer prospects for a great local business. The carrying of the iron ore and limestone of Columbia County to the iron works at Scranton, and the coal of Wyoming to the iron works of Columbia and Montour counties, in connection with all the travel and other local trade which a densely populated district will require, would be enough to make it a profitable road.

REACHING TO THE COAL REGION.

The Carbondale (Pa.) Standard and Expositor says that the Delaware and Hudson Canal Company contemplate a locomotive road from that place to Lanesborough, through Frost Hollow, Herrick, &c., that the surveys have been made, and that ground wlll be broken, probably, next spring. The grand object of this road is to reach the western market with their coal, where the demand for anthracite is rapidly increasing, it being extensively used in furnaces and forges, as far west as Ohio; besides the immense and increasing consumption for culinary and heating purposes everywhere in the West, especially in western New York. A railroad is also in contemplation from Lanesborough direct to the city of Albany.

COST OF SHAFTS.

The total amount of capital embarked in Great Britain in the mining of Coal, is estimated, by good authorities, at $50,000,000. Now let us look for a

moment at one important item of expense—that of Pit Shafts—and here we shall without doubt frighten some of our Penna. Coal traders, by the statement of a sum competent in their estimation for the entire winning of a colliery. A shaft 300 yards deep and 11 feet in diameter—a very common measurement here—would cost ordinarily from $10,000 to $12,500. One, 300 yards deep and 14 feet in diameter, from $12,500 to $15,000. A shaft, eight feet in diameter and about 200 yards deep, may ordinarily be sunk and walled for $15 per yard, and one of 11 feet diameter for less than $25 per yard. These figures are on the assumption that no unlooked-for casualty, such as the inroads of water or the occurrence of treacherous material, be met with. When such is the case, the expense of course is greatly enhanced. For reducing 'feeders' of water, a large pumping engine of from 200 to 300 horse power would cost with masonry, &c., not less than $27,000. In America, such shafts, if found necessary, could not be constructed for double these rates per yard through average soils. I have in my recollection one of only 130 feet in depth, 8 x 10 feet across dimensions, that cost in Pennsylvania $20 per foot, and unwalled or curbed.

To return to England—the winning of a single colliery before the first cent of remuneration reaches the pockets of the projectors will often cost from $250 to $400,000, and even in extreme cases as high as one million dollars.

WAGES IN ENGLISH COLLIERIES.

Let us now consider the costs of the labor that carries on an English Colliery:—A 'getter' or miner is paid 1½ to 2 cents per hundred weight of Coals excavated, and at this rate can average from 81 cents to $1 25 per day; but out of this sum, his "marrows" or assistants who do the business of 'putting' and 'hurrying' for him must be paid, so that his earnings will not average more than 3s. or 75 cents per day at the outside, which is about half the amount paid for the same labor in Pennsylvania. The rest of the underground workmen about a Coal mine, equal to at least one half of the whole staff, are boys from 10 to 16 years—their wages averaging 50 cents per day. On the surface, women are usually employed upon small earnings; probably 1-12 of the entire labor is performed by females. At the Canal mine, Incehall, where from six to seven hundred hands are employed, I found nearly one half to be boys, and at least fifty girls and women. Regarding these facts, together with the admirable system of internal navigation for which she is famed, we can account perhaps for England sending the product of her mines to America over the heads of our Canal Companies in Western Pennsylvania, and to Vienna, in spite of the Austrian Collieries in the neighborhood.

PROFITS OF COAL MINES.

Considering now the question of profits, we may premise that it is of course extremely difficult for any one to estimate the ratio of returns to expenses in enterprises of such a character as are English Collieries, partaking as they do of the nature of private adventures; but Mr. Buddle, the eminent Coal manager and Geologist of New Castle, thought that by no means 10 per cent. had been cleared at simple interest on the Collieries of the North. The profits of the Helton Coal Company, the largest in England, have been stated at from £35 to £45,000, or $200,000 per annum. Before the House of Commons' Inquiring Committee, it was stated by a respectable witness, to be a matter of general complaint, that the Collieries in the New Castle and Durham district do not, on an average, pay more than 5 per cent. per annum; whilst many proprietors evinced anxiety to correct the impressions which they thought had gone abroad as to the great profits which companies were reaping from their Coal investments. These profits, it may be said, are probably smaller in the North, where the Coal lies at a great depth; the veins are of trifling thickness and the mine-

roofs generally more insecure than in the midland counties where these conditions are usually reversed. For instance, in the Monkwearmouth Collieries, near New Castle, only 1-7 part of the Coal is obtained by the system of working adopted and found necessary to insure safety. In Staffordshire, on the contrary, where the roofs are compact, all the Coal may be said to be wrought out, as the proportion left for props is very inconsiderable.

PRICE OF COAL IN ENGLAND.

As regards the prices of Coals in England, I have not been able to perceive any difference between the rates paid per ton in the London market and those paid in Philadelphia for Lehigh and Schuylkill. From 16 to 20 shillings or $4 to $5 per ton is obtained in London for the best qualities. This is probably less than house Coal is commanding at the present time in Philadelphia; but in making a comparison we must not forget the difference in the nature of the fuel at the two places. Barring the 'slack' with which the Pottsville folks in hard winters persist in encumbering the stoves and furnaces of their good easy customers of the Quaker City, the anthracite, which Pennsylvania alone of all the world furnishes in any quantities, is decidedly more economical, producing a greater proportion of heat for the same expenditure of fuel, than the bituminous article which smokes and blackens the cockneys so terribly. In the large towns of the manufacturing district, Manchester, Leeds, Sheffield, Blackburn, Bolton, Bradford, Stockport, &c., which are all situated in close proximity to the mines; coal is certainly very cheap, being no more than from $2 00 to $2 50 per ton of house coals, and from $1 25 to $1 50 for engine coal. At Pittsburgh, which city is in the heart of the Pennsylvania Bituminous field, I believe the same species is delivered for 5 cents per bushel, equivalent to about $3 50 per ton, and this in the face of the fact that there are no shafts whatever with the expensive machinery necessary to work them in the Pennsylvania mines, all the workings being horizontal, and entered from the sides of the banks.—*Correspondent Pottsville Journal.*

APPARATUS FOR MAKING GAS.

Three inventions for producing illuminating gas are exhibited at the Fair of the American Institute, at the Palace, different materials being used in each.

Aubin's Patent Gas Apparatus makes gas out of resin, produces a brilliant light, is very simple in its operations, and well adapted for use in hotels, churches, and private dwellings. The process consists in heating a vessel containing a small quantity of resin over a common fire, and passing the gas thus formed through water. It is then ready for use. The whole apparatus occupies but little space; that shown at the Palace is a stove-like looking affair. We were told that it was capable of making 1,000 feet of gas per diem. It can be used in dwelling-houses with convenience, requires no special attention, and makes no offensive smell. Price, with gasometer capable of holding 200 feet of gas, $250. Cost of light, 1-4 of a cent per hour for each 5 foot burner.

Porter's Patent Wood Gas Apparatus.—This consists of a small furnace with a retort placed over the fire. The gas is produced from pine or other resinous woods, small blocks of which are placed on a shelf within the retort. The action of the heat causes the resinous products of the wood to melt, and, escaping from the pores, they slowly drip down upon the bottom of the retort, where the heat is more intense, and by which they are converted into carburetted hydrogen gas. The gas thus formed then goes through a slight purification, when it is ready for burning. The substance left in the retorts, after producing the gas, is charcoal of a first-rate quality. The light produced from this gas, we observe, is not so brilliant as the other kinds, but it is very cheap and easily made. The apparatus is also very simple, and of trifling expense. One cord of wood, it is said, will produce 2,000 feet more of gas than can be made, by any known process, from a tun of the best Pittsburg coal.

The Maryland Gas Apparatus consists of a cylinder stove containing a hemispherical retort, a cast iron box or condenser, and a tank with a gas-holder, as is common to other gas works. The material used is a cheap resin oil, furnished, we are told, at 18 cents a gallon; each gallon will make 100 feet of gas of double the illuminating power of coal gas. In using the apparatus, the retort is first heated to a cherry red. An oil cock, attached to the reservoir above, is then opened a little to allow the oil to pass by the syphon into gas, and passing through a purifying chamber in the upper part of the retort, is conveyed by a pipe to the condensing box, and thence to the gas-holder, ready for use. The smallest-sized apparatus is capable of producing 300 feet of gas in three hours, which is as much as an ordinary family will consume in a week. Cost $350 put up.—*Scientific American.*

PEAT CHARCOAL.

The Admiralty Board, among other matters, have announced their intention of receiving tenders for the conveyance of 84 tons of peat charcoal to Scutari. The identification of the use of this material in the government service is very important, as some evidence of the acknowledgment that SCIENCE, probably, has accomplished something further, which may tend to ameliorate the privations and exigencies, or to administer towards the necessities of those who, at the present time, may be suffering from disease, or otherwise, in the abode of fever and malignant disorder. As a disinfectant, the properties of charcoal can scarcely be too highly estimated; and when the great rise in price is considered, which recent events have brought about, in the absence or costliness of a sufficient supply of wood, other materials, equally applicable to the purpose, must necessarily be resorted to. The peat bogs of Ireland, as well as those at Dartmoor and elsewhere, are quite sufficient to produce an almost inexhaustible supply of this commodity, which, under Mr. Gwynne's process of solidification, has been carried out so advantageously.

HOW TO BURN COAL.

Putting up stoves for fall and winter is an important duty now being performed by many. The high price of poor wood, and the almost total absence of good, renders the use of coal a matter of economy. Hence any thing relating to the manner of burning this precious mineral will be of service to some, if not to all our readers. An Albany paper says:

"There has been a great deal said and written on the true principle of burning coal. The art of burning coal is not yet properly understood, as it ought to be. Too much coal is usually placed in the stove, by which the draft is destroyed, and gases are imperfectly consumed. Stoves should be constructed with air-tight doors, and means of supplying air to the top of the coal fire as well as the bottom. The feed door should never be opened except to supply fuel. When open, of course cold air rushes in and cools the sides of the stoves, wasting coal. When too much air gets in at the draft-door and ash-pit, the draft is so strong, that either your stove becomes too hot, or you open the feed door to correct the evil—losing heat. When no air is supplied to the top of the fire, about half of your coal escapes as vapor of carbon, unburnt for want of air, without which, combustion cannot be perfect. Small flues should be in the stove, to admit a stream of air heated by contact with the stove, and distributed to mix with the gas on the top of the fire."

We cut the above from one of our exchanges. The writer is correct. In almost every instance too much coal is put into stoves to burn with advantage—and we must confess that we have never yet seen a stove properly constructed to burn anthracite coal. The great defect is the want of a small tube or tubes leading from the bottom of the stove or from the outside, to carry air to the top of the fire inside, while the doors are shut. Such a tube

or tubes could be made in the castings without interfering with the ash-pan or doors, and ought to be on the opposite side where the gas flue leads off. Stoves, to burn coal economically, ought to be so constructed as to close all the doors after the coal is ignited, admitting but a small quantity of air at the bottom, or ash-pan, sufficient to keep the coal burning gradually, and then regulate it with a damper in the flue. The flues or tubes extending from the bottom of the stove to the top of the fire, would then feed the top of the fire, and aid the combustion. We have seen a tube run across the fire under boilers open at the ends to admit air outside the stack, which are perforated with holes so as to admit the air on the surface of the fire under the boilers, which increases the flame and economizes the fuel.—*Pottsville Journal.*

NEW CREEK COMPANY.

This company is now busily engaged in opening new mines, both of coal and ore. The coal is said to be of the very best quality, and is taken from a stratum six feet in thickness, lying beneath the "big vein." The vein of ore is eight feet in depth, and is said to be a rich hematite, a very valuable ore; and if it exists in the quantity represented, it is more valuable than the coal.—*Cumberland Telegraph.*

THE DARLINGTON CANNEL COAL.

The Darlington Cannel Coal Railroad Company of Beaver county are now in successful operation, sending out about one hundred and fifty tons per day, but cannot half supply the demand. A large amount of it is brought to Alleghany City and sold for domestic purposes, for the large bakeries and for tempering glass. For this last purpose bituminous coals do not answer, and our glass manufacturers have heretofore been compelled to use wood. The Cannel coal is now used in two of our glass houses, and at one in Bridgewater, Beaver county, and it is said to be better and cheaper for tempering than wood.

A party of Pittsburghers, Messrs. Cheney, Watson & Co., have purchased a site at the junction of the Darlington road with the Ohio and Pennsylvania road, and have commenced the erection of a large manufactory for the purpose of distilling oil from the Cannel coal, and entered into arrangements with that company for the supply of coal. By actual experiments it has been ascertained that it contains at least forty gallons of oil to the ton, and the expense of making it is not more than fourteen cents per gallon. The oil is of a superior quality for light; when burning emits neither smoke nor smell, and is not explosive. It is now manufactured successfully in New York, and sold at one dollar per gallon. It is also valuable for machinery, as it neither gums nor does it congeal until the mercury sinks at 15 degrees below zero. From the cheapness with which it can be made it is evident that it will soon be produced in quantities, tending greatly to reduce the price—a very desirable matter. The Darlington Company owns five hundred and fifty acres of Cannel coal—have at a great expense completed their road, and are now in full connection with the lakes, and the Ohio river,—a central position that must secure them great advantages.

This vein of Cannel coal averages from fourteen to fifteen feet in thickness, and is overlaid with a vein of Cannel coal shale of ten feet in thickness, which, although not good for fuel, contains as much oil as the coal; the shale being composed mainly of oil and earthy matter, and the coal of carbon and oil. It is computed that, at a low estimate, there is in every acre forty thousand tons of the oil-yielding substance: a mine richer in wealth than the gold-yielding quartz of California.—*Pittsburgh Post.*

ALABAMA COAL.

Among the most important and successful enterprises of our State, says the Southern *Times*, the Alabama Coal Mining Company, located at Selma, has taken

a prominent position. It was organized in May last, under a favorable charter from the Legislature. Its present capital is $200,000. A gratifying fact in this connection is, that nearly all the capital stock has been taken by citizens of our own State. A glance at the resources and operations of the Company will be sufficient to show its claims on public attention and confidence. Located in Shelby county, Ala., about fifty miles above Selma, the coal fields owned by the company cover a space of some five thousand acres. Ten or twelve mines have already been opened, and they are yielding an abundant supply of valuable coal. The facilities for transportation are as easy and convenient as could be desired. The main trunk of the Alabama and Tennessee Railroad runs near the mines, and branch tracks, connecting the coal fields directly with the great line of the road, are now in process of construction. So soon as these are completed, a prompt and expeditious mode of transporting the coal to Selma will be provided, and a full supply will be kept at the chief depot for distribution throughout the country. To facilitate this distribution the company has purchased boats and barges, which will be ample to supply the markets on the Alabama river. The experience of the country has demonstrated, that immense quantities of coal can be conveyed over railroads and similar thoroughfares of trade, to accessible markets at a low rate, and that thereby the use of this economical and desirable fuel can be put within the reach of moderate means. Owing to these facts, the company, so soon as its operations are extensively organized, will be able to offer great inducements to consumers. Nothing can be more certain than that all improvements form a system. One thing depends upon another. If coal, iron, and other materials can be had by means of railroads, they will soon be followed by the establishment of successful manufactures.

ARCTIC COAL.

The Hartstein Arctic Expedition visited Haroe Island, lat. 70° 25′ N., lon. 54° 45′ W., and obtained bituminous coal of an excellent quality. The coal strata crops out within a few feet of the shore in the side of a hill, and is from four to five feet thick, and a few feet above the sea level.

The samples furnished by the officers contain small pieces of crystallized naphtha, of a color as bright as the finest specimens of gum arabic. On exposing this coal to the action of our atmosphere it loses weight rapidly.

The English analysis is as follows:

Specific gravity	1,3848
Volatile matter	50.6
Coke, common	9.84
Fixed carbon	39.56

The natives burn this coal in stoves, and prefer it to the English. The island of Disco contains abundance of this coal. Captain Hartstein mined the coal on Haroe Island, and it was brought on board the vessel in tubs. Captain Inglefield visited these mines and obtained seventy tons of coal, and remarked that a thousand tons could be obtained in a few hours.

NEW YORK COAL EXCHANGE.

This Association is now fully organized, and the following gentlemen constitute its officers: President, S. S. Ward; Vice President, George H. Potts; Secretary, George M. Rose; Treasurer, S. M. Phillips; Directors, H. Reese, Peter Clinton, Joseph Baker, Joseph Noble, G. P. Morris, G. F. Powers, Wm. Rogers, T. Maher, T. Truslow, Jr.

MILES RUN TO ONE PINT OF OIL.

The amount of oil used on the mile, run by each engine of the Albany and Utica Division of the New York Central Railway for the month of September,

shows a great gain in economy over former months. There are 26 engines, and the division is 95 miles long. The following is a correct written statement of the past five months:

Months.	Miles run.	Pints of oil used.	Miles run to 1 pint of oil.
May	49,988	3,624	13 80-100
June	49,039	3,798	12 91-100
July	42,314	2,879	14 71-100
August	46,675	2,904	16
September	48,305	2,554	18 91-100

IRON AND ZINC.

WASTE GASES FROM IRON FURNACES.

It was in the year 1812 that a patent was granted to Aubertot, for the application of the combustible gases escaping from an iron furnace to metallurgical purposes, and in the year 1830, attempts were made at the lead works at Halsbrüette, near Freiberg, to employ the flame of coal gas in cupelling the silver-lead; but neither of these attempts at introducing gaseous combustibles as fuel were followed up, until the subject was carefully investigated by Faber du Faur, about sixteen years ago, at an iron work in Würtemberg, the result of whose laborious experiments has now led to very general adoption of the waste gases from iron furnaces as fuel, and indeed to the production of gas to be specially applied for the purpose.

The property of burning with flame is common to most of the natural fuels, and is due to the evolution and combustion, at a high temperature, of the combustible gases, carbonic oxide, hydrogen, carburetted hydrogen, &c.; but even those fuels which, like charcoal and coke, usually burn with little or no flame, may be made to afford combustible gas under peculiar circumstances—for instance, when ignited in large quantities, with a limited supply of air—when a large proportion of the carbonic acid, at first produced, becomes converted by contact with red-hot charcoal into carbonic oxide.

The method of conducting away the waste gases from an iron furnace, as carried out by Faber du Faur, as described in "chemistry and its applications," is as follows:—At the proper distance from the throat of the furnace, from three to twelve feet according to its construction, several apertures are made in the sides, from which flues lead to the annular flue, the latter being connected with the iron pipe for conveying the gases to the place of consumption. The flow of gas can be regulated by the damper, and above each aperture is a movable lid for the purpose of clearing the flues from furnace dust. Closed apertures admit of the pipe being cleansed.

Mr. Budd, of the Ystalyfera Iron works, Swansea, applies the heated gases which escape from the anthracite furnaces for heating the blast and raising steam in the blowing engine. In his arrangement the excessive heat of the gases only is employed, as they are not ignited, but simply passed over the pipes which convey the blast, and through the pipes which pass through and over the boilers. The apertures are only about three feet from the mouth of the furnace. and the hot air pipes are enclosed in an oven on a level with the outlet pipe, and the gases are drawn away by a small chimney in connection with the ovens. At Coltness Iron works, Scotland, these gases are employed in a state of ignition, either alone or mixed with air, to calcine the black, hard ironstone; and it is proposed that the limestone used as a flux shall also be rendered caustic by the same agency. The gases are collected at about four or five feet

from the mouth of the furnace, and conveyed by a horizontal pipe to the kilns situated on a rising ground immediately behind. The use of these gases has been found in no way prejudicial to the regular working of the furnaces, and in calcining ironstone alone, it is said to reduce the cost of pig iron 2s. 6d. per ton, in coal, dross, and wages together.

In some of the Welsh furnaces it has been found useful to close, or partially close the tops of the furnaces, for drawing off the gases more completely. Although the closing of the furnace has sometimes been found to interfere with the working, the plan has been adopted at the Ebbervale, and other works, without injury to the iron process. An inverted truncated cone is suspended from the top of the furnace, the bottom truncated end being closed at will by a second cone, the apex of which rises through the centre of the upper cone, and is attached to a central chain with an adjusting lever. When the lower cone is elevated, the gaseous escape is shut off, so that the current can only pass through the flue. The furnace is fed by lowering the inner cone, when a fresh charge of fuel, &c., previously placed in the upper cone, is delivered towards the sides of the furnace.

GENERATORS.

Special furnaces for generating gaseous combustibles are employed in certain localities where there is an abundance of otherwise valueless fuel, such as wood-shavings or saw-dust, small charcoal and dust, turf, refuse lignite, and small coal or slack. These substances are heaped together in long upright furnaces, and the combustion is kept up with only the requisite amount of air for producing a maximum quantity of carbonic oxide gas.

These generators are constructed either with or without blast of air. The following is a description of a generator without blast, used at Mägdesprung in the Hartz: The central part or body of the furnace is cylindrical, five feet in diameter and five and a half feet high; the upper part and the under part are conical; the upper four and a half, and the under two feet high; below is a conical slab grate, beneath which is an ash pit closed by an iron slab. An aperture, immediately above the grate, is capable of being closed by an iron door. When the damper is raised, the gases escape by a duct into a square flue, the upper part of which is constructed of iron plates, and covered with sand to retain the heat. The throat of the furnace is separated from the body by an iron damper, and the top closed by an iron lid. The space between the damper and the lid is just sufficient to hold one charge of combustible matter, with which the generator is supplied at intervals, and by withdrawing the damper while the lid is in its place, the charge can be introduced without any escape of gas through the throat.

In working the generator, a layer of burning fuel, which we will assume to be charcoal, is thrown upon the grate, and the whole furnace filled up with the same material. The door being closed, air enters below the grate through three apertures, two inches in diameter, in the slab. The carbonic acid at first produced by the ignited charcoal, on traversing the upper layers of red-hot fuel, soon becomes converted into carbonic oxide, which gas in the upper regions of the generator being only mixed with nitrogen, exerts no further influence on the fuel. The progress of combustion is under entire control, by means of the damper and the three apertures, and can be observed through them. The interior of the furnace as viewed through the lowest aperture should appear in a full glow; the combustion as viewed through the middle aperture should be less intense, and no signs of ignition should be visible on a level with the uppermost, for when this is not the case, there is danger of much carbonic acid being mixed with the carbonic oxide, and more fuel must be added, and the draught diminished.

A generator intended to work with a blast of air, was erected at the iron works of Audincourt, under Ebelmen's directions. In its general proportions it resembles a small iron furnace, the height from the hearth to the throat being about ten feet, the widest part above the boshes being three feet four inches, the narrowest part above the hearth about ten inches, and the throat

thirteen inches. A cast iron pipe descends from the throat about four and a half feet into the body of the furnace, and is kept constantly filled with fuel, which at Audincourt is small charcoal. The lid is only necessary when fuel in larger lumps is employed, the small pieces offering sufficient obstacle to the passage of the gases, which find free passage into the space in which there is no fuel, and thence to the flue. A much more abundant supply of gas is obtained with generators of this construction than with the former, and the pressure of the blast being considerable, they can be conducted in downward direction to the place of consumption. One great obstacle to a regular supply of gas is occasioned by the fusion of the ash of the combustible to the sides of the furnace which diminishes the draught. This has been partially obviated, by mixing about one and a half parts by volume of iron furnace slag and clay with every hundred parts of combustible, which forms with the ash an easily fusible compound, that can be run off from the bottom of the furnace. The gases collected from copper smelting and puddling furnaces have not been found applicable as fuel.

IMPROVEMENT IN THE MANUFACTURE OF CAST AND MALLEABLE IRON.

Prof. Frederick Grace-Calvert, of Manchester, has patented an invention, the object of which is to obtain a better quality of cast and malleable iron from certain iron slags or cinders, known by the names of puddling refinery, and heating slags or cinders, than is effected at the present day. The usual way of applying these slags or cinders on a blast furnace consists in adding them, either alone or mixed with ironstone, without submitting them to any previous preparation, except sometimes burning them in a heap. The consequence is, that as they descend in the furnace they are soon carried to a bright red heat and fused, and get mixed with the various materials which compose the charge of a blast furnace. A portion of these slags or cinders, falling on mine or coke, is not fluxed, and thus gradually finds its way to that part of the furnace where cast iron is being produced, and uniting with it, descends into the cupola or the blast furnace. It is easy to understand how the above iron slags or cinders, mixing themselves with the cast iron, injure its quality, for iron slags or cinders are chiefly composed of silicate, sulphuret, and phosphuret of iron, which act most injuriously on the quality of cast and malleable iron.

The mode of operating, so as to effect the complete fluxing of the above slags or cinders, and thus prevent the silica, sulphur, and phosphorus arriving in contact with the cast iron which is being produced, is as follows:—The first process consists in reducing the above puddling, refinery, and heating furnace slags or cinders into coarse powder, which is done by any of the ordinary mills and grinding apparatus now in use, and then adding to them about one-half their weight of slaked lime, made into a thick paste. They are then well mixed together, and the mass is made into lumps or bricks of a convenient size, which are dried or not, according to circumstances, previously to adding them at the top of the blast furnace; or the dried lumps of lime and slag or cinders may be calcined in a separate furnace, and afterwards introduced, with ordinary mine, at the top of the blast furnace; or the mass of lime or slag may be mixed with coal, coke, or charcoal, and calcined in a furnace, or introduced into crucibles, and thus separate the iron which it contains previously to its addition on the blast furnace. The patentee remarks, that heating slags or cinders generally does not require roasting, but that refinery and puddling slags often do.

The second process consists in roasting or oxidizing the iron slags or cinders before they are mixed with slaked lime. To oxidize these slags or cinders, two different processes are adopted. The slags are reduced to fine powder, and introduced into an oxidizing furnace, such as is used for roasting copper ores; and whilst the powder is carried to a dull red heat it is well stirred, so as to transform the iron or the protoxide of iron it contains, into peroxide, the silicum into silica, the phosphurets into phosphates, and the sulphur into sul-

phurous acid. When the powder has assumed a bright red color, and no more sulphurous acid is produced, it is taken out of the furnace and mixed with slaked lime, and applied as above described.

The same purpose is attained by breaking the slags or cinders into small fragments, and introducing them with a small amount of coal into an ordinary kiln, or in one made of four walls which have numerous holes in the sides; the object of which is to admit freely the oxygen of the atmosphere, and which holes are also employed to remove the oxidized slags or cinders. These kilns are worked like ordinary limekilns—viz., the slags or cinders, mixed with a small quantity of coal, are constantly added at the top, whilst the oxidized slag or cinder is removed at the bottom by the opening or openings which exist there, and then the prepared slags or cinders are treated with slaked lime as before described.

The third process to which the patentee submits puddling, refinery, or heating slags or cinders, is to reduce them into a powder, and introduce them into furnaces which communicate with the blast furnace by means of long flues, into which the volatile products given off from the mouths of the blast furnace or of the coke oven are passed. When the powdered slags or cinders are not sufficiently heated by the gases for these to act upon the component parts of the slags or cinders, a gentle heat is applied, so as to carry them to a dull red heat; then the silicates of protoxide of iron are decomposed, and metallic iron is produced. When the operation is completed, they are taken out and allowed to cool. Such reduced slags or cinders having been made into powder, are to be treated with slaked lime, in manner before described.

The patentee claims the use of hydrate of lime, or slaked lime, in combination or intimately mixed with heating, puddling, and refinery iron slags or cinders, both before and after calcining the latter.—*London Mining Journal.*

REVERBERATORY FURNACES.

Mr. J. Boydell, of Anchor Iron-works, Smethwick, England, has patented an improvement in the beds of reverberatory furnaces used for puddling iron. This invention relates to the employment of the refuse product of pyrites, principally composed of iron, in making the beds of reverberatory furnaces used for puddling iron. In the burning of iron pyrites, when manufacturing sulphuric acid or sulphur therefrom, the residual matters (resulting of oxides of iron combined with more or less impurities) have heretofore been thrown away as refuse, and it is the application of this refuse matter in the puddling of iron which constitutes the present invention; and the process of puddling will, by such application, be rendered less expensive, by reason of the low cost of such refuse matters. The oxides of iron obtained from pyrites in the manufactures above mentioned differ in quality, some being mixed with considerable quantities of quartz or silex, whilst others retain quantities of sulphur; those possessed of either of these matters to any very great extent, should be rejected. Those lumps which present to the touch a soft and smooth surface, and are of a reddish purple in color, are the lumps which should be sorted out of the heaps for use in the puddling furnace; and those which present a hard, sharp, gritty, and cinder-like surface to the touch, in consequence of the silex present, should be rejected, as well as those which present a white crystalline or quartz-like fracture, and those indicating the presence of sulphur. The lumps of the refuse matter having been sorted, those which have been selected for use are to be employed in the making of the beds of puddling furnaces, in like manner to that ordinarily practised when using oxide ores of iron; the refuse oxides from pyrites being used either alone or in combination with the oxides of iron heretofore employed. The patentee claims the application of the refuse products of iron contained in burning pyrites (for the manufacture of sulphuric acid and sulphur) in the making of the beds of reverberatory furnaces used for puddling iron.

"BLACKENING" FOR FOUNDRIES.

Mr. E. Bow, of Glasgow, has patented the application or employment and use of what is commonly known in Scotland as the "Boghead or Torbane Hill mineral" or coal, in the manufacture or production of what is technically known by the iron founder as "blackening," used for foundry purposes in the preparation of the moulds in which castings in metal are to be made. The argillaceous bituminous mineral, hereinbefore referred to, is prepared for use in the manufacture of blackening, by subjecting it to the action of heat. It is taken as dug from the earth, and is primarily burnt or distilled, or otherwise treated by a heating process, in such a manner as to evolve and carry off its chief volatile constituents,—the solid residuum or cinder alone being retained and applied in the preparation of the blackening. This residual matter or cinder is ground or reduced to the condition of a powder, in any convenient manner, and the reduced mass, so prepared, is treated in the ordinary manner, as pursued in the manufacture of blackening of the common kind. The blackening prepared in this manner is of excellent quality, and is much cheaper than that usually employed. Although the Boghead and Torbane Hill minerals have been mentioned as the material especially suited for the manufacture of blackening for foundry purposes, yet all coals or mineral substances, of the class or family above indicated, or embodying the general constituents of these minerals, and Parrott coals, generally, are suited for carrying out this invention. The patentee claims the application and use of what is commonly known as Boghead or Torbane Hill mineral or coal, or other argillaceous bituminous minerals, embodying the general constituents of such substances, in the manufacture or preparation of blackening for foundry purposes.

APPLICATION OF THE "HIRUDINE" TO FURNACE BLAST.

The Hirudine is an appliance that affords a happy solution of the long felt difficulty of economically securing a blasting power to fulfil all the various requirements of furnace operations. While on the one hand it is as inexpensive for working as the fan, and even more commodious in arrangement, it possesses, on the other, an action as potent and complete as that of the far more costly cylinder. The construction of the Hirudine is essentially simple and durable. For the furnace blast, it may be fixed beneath the ground, or under the floor line of the works, so that the apparatus will occupy the least possible space. A tolerably rapid movement of the undulating band will convey a strong and unintermitting draught of air to the furnace, and with far fewer revolutions and consequent wear of machinery, than with either the fan or cylinder. For mining drainage, mill, and other purposes demanding great pumping power, the Hirudine is stated to afford considerable facilities, the mechanism of the pump being precisely similar to that of the furnace blast or ship propeller. At each revolution of the shaft, the whole column of water in the tube, whatever its length, is twice forcibly discharged, and thus with some 12 or 15 revolutions per minute a continuous body of water is engaged, and ejected at a rate of 50 to 60 miles per hour, though the machinery only moves at from 100 to 200 feet in the minute; and thus the inventor alleges the largest amount of work is accomplished with the least possible amount of strain, friction, or vibration.

COATING METALS.

Mr. James Hulls, of Plaistow, and Mr. J. Lowe, of Lambeth-road, have patented some improvements in coating iron and other metals with lead. The invention relates to certain methods of preparing the surfaces of metals to be coated with lead. These methods are somewhat different for different metals. The following is the process for preparing iron:—The iron is first submitted to the action of dilute sulphuric acid, in order to remove the scale from its surface. The first bath consists of one part by weight of sulphuric acid mixed

with three parts of distilled water. The iron is allowed to remain in this from five to eight hours, according to the state of its surface, which may be judged of by examining it from time to time as the work progresses. The iron when removed from this bath is to be thoroughly scoured with fine sand, and cleansed in distilled water, to free it from all trace of the sulphuric acid, and to remove loose matters from the surface. It is then to be immersed for a few minutes in a bath consisting of 1 part ammonia and 16 parts of distilled water. When removed from this bath it is submitted to the action of chloride of zinc, by immersion during one hour in a bath formed by dissolving 1 part by weight of zinc in 7 parts of hydrochloric acid, and afterwards plunged into a solution of sal-ammoniac, mixed in the proportion of 1 part of sal-ammoniac to 20 parts of distilled water.

COATING IRON AND STEEL WIRES.

Mr. Johnson (for a correspondent) has patented an improved process for coating iron and steel wires with other metals or alloys. In carrying out this invention the wires to be operated upon are wound upon vertical rails placed at the extremity of the machine, upon which they pass through a double vessel, containing a solution of double chloride of zinc and ammonia, or a simple solution of chlorhydric or hydrochloric acid, diluted with water. The second portion of the vessel serves to receive any acid which may drop from the wires after immersion, and during their passage through cushions attached to the vessel, from which cushions the wires proceed to the metal bath (whether of zinc or other metallic alloy), the molten metal being contained in a cast-iron vessel over the furnace. On leaving the bath the wires are entirely coated with metal, and are passed between two steel gauge plates, which remove any superabundant amount of metal, and produce the smoothness desired. The wires thus coated are cooled by jets of cold water.

CAST STEEL.

In manufacturing the commoner descriptions of steel, particularly cast steel made from English iron, oxide of manganese has been largely used; its use produces malleability to a common metal, and the effect upon the steel during the operation of melting has been a subject of much speculative discussion amongst scientific men.

I find no alloy of metallic manganese with steel, and certainly the very small quantity of carbon which the oxygen of the manganese takes up, affects the degree of hardness very slightly.

I have examined this interesting matter, and in doing so I have set up no theory of my own, but I have carefully examined the scoria or slag produced, when oxide of manganese was used, and when it was not; the metal also has been carefully weighed before and after melting. In my experiments I used English iron, which is so coarsely manufactured that it is mixed up with much deleterious matter. In more nicely investigating this subject I used a Swedish iron, which contained a large amount of silicate of iron. I charged two crucibles with this Swedish metal properly converted into steel, each 30 lbs. Into one I put 3 per cent. of oxide of manganese—into the other nothing. Both crucibles were in one furnace, and melted down in about the same length of time. In that crucible containing the oxide of manganese, I got more slag and a little less metal than in the other. The ingot melted with manganese drew very sound under the hammer; the other was filled with cracks. On an examination of the metal and the slag resulting from each crucible, I found that the oxide of manganese had attacked and dissolved all the silicate of the metal it could find, as the metal melted, and converted it, with other deleterious matter, into a glassy slag, which is very fluid. The steel being thus freed from these noxious matters, is precipitated by its

own gravity, and the molecules of metal coming in closer contact by the removal of the foreign matter which before more widely divided them, the metal becomes very malleable under the hammer.—[*C. Sanderson.*

THE IRON REGION AND FURNACES IN SOUTHERN OHIO, BY W. W. MATHER.

The resources of this region have been made known in the Ohio Geological Reports in 1837–8–9, and it has not its superior, it is believed, anywhere, in either of the requisites for the profitable production of iron—neither in the capacity of production over an equal area—nor in the qualities of iron produced for general and for special uses.

Its capacity is estimated at 8,000,000 tons per square mile, over 360 square miles, with timber, coal and limestone, sufficient to smelt and manufacture it close at hand. It is situated in a rich agricultural region in a high state of productiveness, where all the wants of a manufacturing community can be easily supplied, and more cheaply than any other manufacturing district of our own or any other country.

It is traversed by canals and railroads, and by the Ohio river, and offers facilities for easy and cheap transportation in every direction.

It offers unexcelled, perhaps unequalled advantages for the manufacture of pig iron and railroad bars with stone coal, and the time is believed to be near when this business will be commenced, and will compete with other points in the production of rail bars. The stone coal has been tried, and has resulted satisfactorily in making iron. In 1838–9, the resources of this region were carefully examined under the authority of the State of Ohio, and made known in the Geological Reports to the Legislature. Subsequent residence of years in that region, and the constantly increasing developments from observation, and from mining and furnace operations, confirm the views then advanced.

In 1838 there were 8 furnaces in Lawrence County, 5 in Scioto County, and 1 in Jackson County. Now there are in what were then the bounds of Jackson County, 14 furnaces. Then no railroad existed, now two pass through Jackson County, and another is graded. One through Scioto, and two through Lawrence.

Furnaces in Southern Ohio.—The following is a list of such furnaces as I can recall to mind in the iron region of Southern Ohio, mostly in Lawrence, Jackson, and Scioto Counties, with three in Vinton, one or two in Gallia, one in Athens, and one in Hocking Counties. The list is imperfect, but embraces nearly all.

La Grange Furnace, Lawrence County, Ohio; Hecla Furnace, do.; Pine Grove Furnace, do.; Union Furnace, do.; Vesuvius Furnace, do.; Ætna Furnace, do.; Lawrence Furnace, do.; Centre Furnace, do.; Mount Vernon Furnace, do.; Buckhorn Furnace, do.; Olive Furnace, do.; Washington Furnace, do. 1 Rail mill building at Ironton, Lawrence County, Ohio; 1 do. at Hanging Rock, do ; 2 Rolling mills for Mer. iron, Ironton, do.; 1 do. for Mer. iron, Hanging Rock, do.; 2 do. Nails, Ironton, do.; Gallia Furnace, Gallia County; Franklin Furnace, Scioto County, Ohio; Franklin jr. Furnace, do.; Clinton Furnace, do.; Bloom Furnace, do.; Scioto Furnace, do.; Empire Furnace, do.; do. Furnace, do.; do. Furnace, do.; 1 Rolling mill for Mer. iron, Portsmouth, Ohio; Jackson Furnace, Jackson County, Ohio; Keystone Furnace, do.; Buckeye Furnace, do.; Madison Furnace, do.; Jefferson Furnace, do.; Monroe Furnace, do.; Latrobe Furnace, do.; Lick Furnace, do.; Cincinnati Furnace, do.; do. Furnace, do.; do. Furnace, do.; Eagle Furnace, Vinton County; Hamden Furnace, do.; Big Sand Furnace, Athens County; Big Sand Furnace, Hocking County.*

Waste Gases and Heat Economized.—Two of these furnaces, viz: Monroe and Lick furnaces, both intended to be worked with stone coal, are not yet

* 24 furnaces and six rolling mills have been built in this region, since 1838, and another at Pomeroy, and many at Cincinnati, dependent mainly on this iron region.

completed. All except Olive use the hot blast, the air for which is heated by the waste gases of the furnaces. The boilers for driving the blast machinery in all these furnaces are heated by the combustion of the waste gases conducted from the tunnel head under the boilers, 40 to 60 feet long, to the stack. In the draught stack is the apparatus, through which the air forced from the blowing cylinders circulates, and becomes heated to 600 or 1000°, and is conducted through pipes thence in the flue under the boilers, and thence down by the side of the stack to the tuyere and tuyeres. The air at the tuyeres is of such a temperature as readily to melt lead.

Size, Stock, and Production of Furnaces.—All these furnaces, with the exceptions named, are charcoal furnaces 36 to 45 feet high, and from 8 to 12 feet in the boshes, most of them 8 to 9 feet. Two, viz., Empire and Washington, of the larger size, have two tuyeres. These furnaces make from 1500 to 3000 tons of iron per blast, of usually 200 days on an average, and the usual average production of the whole of the furnaces is about 2000 tons each, per annum.

The usual consumption of the stock is rated at 2¼ tons of raw damp ore from the mine, and 200 bushels of charcoal, and ¼ to ½ ton of limestone for each ton of iron produced. This allowance of stock is found in practice to be amply sufficient, and generally, more than a ton of iron is made from this amount of stock. It was not so formerly, as you can see from Dr. Briggs' statement in the 1st Geol. Report of Ohio, page 91.

The daily production rates in the different furnaces from 7 to 10 tons per day, in the medium size, and 10 to 15, or even more sometimes in the larger sized charcoal furnaces. The daily and annual production of each of these furnaces is double that formerly obtained ten or twelve years ago in the same stacks, and same sized furnaces.

Temporary Stoppage of Furnaces.—Some of these furnaces stop work over Sunday without any inconvenience, by cutting off the blast, covering the tuyere holes with sand, and the dam and partly up the tymp plate, braize or small charcoal is heaped, and covered with a thick layer of sand, and the tunnel head covered by an iron plate. All access of air, except a minute quantity, is thus cut off: the fuel cannot consume, nor the heat escape. This is done at midnight on Saturday, and at midnight on Sunday the coverings are removed, and the blast put on by starting the boilers with an extra fire on the grate bars at the tunnel head.

Where this is practised, the furnace men have a day of rest, with the privileges of the Sabbath, without detriment, it is said, to the proprietors. Charcoal furnaces with some precautions can be stopped up a much longer period, if there is no iron in the hearth to chill, and a small burden of ore and limestone in stack. Jackson furnace once stopped for weeks in this way, having exhausted her stock, and could not haul in consequence of the deep mud in the winter, and on getting in stock, resumed her blast by unstopping, putting on blast, and then adding her burden of stock as usual. Pine Grove furnace was the first to observe the Sabbath day, by direction of her owner, Robert Hamilton, Esq. It was not before deemed practicable, but he showed that it could be done, and the stopping a furnace is now often practised, not only for the Sabbath, but for repairs, or other causes, requiring a temporary suspension.

It could not perhaps be as readily practised in stone coal furnaces as in charcoal furnaces; but for the short period of a day, with the thick walls and imperfect conducting power of the materials of our furnace stacks, it is thought little or no inconvenience need be experienced.

Ores used in Southern Ohio.—The ore generally used in the Southern Ohio furnaces, and that which is preferred, is called the "*limetsone ore.*" It is a seam or stratum of yellowish brown limonitic ore (hydrated peroxide of iron) near its outcrop on the hill-sides, but when taken from under more than 15 or 18 feet of earth or rock, it is a carbonate of iron, like the gray ironstone of the coal formation in other parts of the United States, of England, Wales and Scotland.

The outcrop ore only is used, and there is enough of this to last for a long

time. This bed of iron rests on a gray limestone, and seems to be almost co-extensive with that rock. The limestone is associated with workable beds of coal. In some districts of Southern Ohio, the coal is 4 to 6 feet thick, covered by 4 to 8 feet of gray limestone as a roof, and this limestone is a level floor, on which the iron ore, from 8 inches to 2 feet thick rests. All these strata extend nearly horizontally through the hills, and across the valleys they are found at a corresponding height in the opposite hills.

There are numerous other seams of iron ore, called, when continuous like the blocks of flags in a pavement, *block ore*, and when the stratum is composed of nodular or ovoidal masses, *kidney ore*. Some furnaces use these ores mainly, and the kidney ore is the purest and best, but costs more to mine it. The limestone ore works easiest, and makes excellent iron, and all the furnaces use it if convenient of access. The block ores are most abundant, and most easily procured, and many of them are of excellent quality, working easily, and making good iron. Some are coarse and sandy, and are not used, though they may, and will be in the future, when the smelting with stone coal shall be well established in this iron region.

JOURNAL OF GOLD MINING OPERATIONS.

CALIFORNIA STATISTICS.

We have the returns of the census for a few counties in California, and in anticipation of the full returns of the State, note a few of the facts they present.

El Dorado County has four quartz mills in operation, which crush 56 tons of rock daily—yielding per ton, $15 to $75.

In Trinity County, the bankers and express men annually buy 78,000 ozs. of gold dust, dug in the county; also a small quantity of platinum.

There are 247½ miles of flumes and mining ditches within the county limits.

In Shasta County: quartz mills, 2; cost, $40,000; but one at present in operation, which crushes 180 tons of quartz per month; cost of running per month, $1,680; yield per month, $5,400.

There is one artesian well in process of being bored. At present, it is 93½ feet deep, with 52 feet of water; the bore is 6 inches. The different strata gone through thus far, are as follows, viz: Red clay 2 feet, gravel and boulders intermixed with red clay, 17 feet, white clay 8 feet, hard sandstone 3 feet, white clay 5 feet, hard sandstone 2½ feet, white clay 14 feet, washed sand 1½ feet, white clay 8 feet, white clay intermixed with sand 2½ feet, white clay hard and compact 17½ feet, washed sand 1½ feet, and gravel 2 feet.

In Tuolumne County the ditch of the Tuolumne County Water Company is assessed at $275,000. It commences at the South Fork of the Stanislaus, and with its branches, extends fifty miles. The Hydraulic Ditch extends from the Tuolumne River to Sonora, and is, with branches, sixty miles long. Its construction cost $300,000, but it is assessed at only $30,000. Street's Ditch, from Sullivan's Creek to the Tuolumne, is between fifty and sixty miles long, and has cost $175,000. The Stanislaus River Water Company's ditch will be about the same length when completed. The capital stock is fixed at $300,000, $80,000 of which has been expended. The Jamestown and Chinese ditch is seven miles long, and was built at the cost of $12,000. In addition to the above, there is the Chile Camp ditch, value $8,000, length three miles; the

Pine ditch, value $2,000, length five miles; the Yorktown (Brunton's) ditch, value $6,000, length five miles; Republican ditch, value $3,000, length four miles; Jamestown ditch, value $1,000, length two miles; the Wood's Digging's ditch, value $8,000, length ten miles. From this it will be seen that Tuolumne County has in operation, and in course of construction, 255 miles of canals; of this, not more than thirty-five miles remains to be completed. The whole original cost, thus far, of these works, cannot fall short of $1,800,-000, and probably when they are completed, the amount will come up fully to $2,000,000.

NORTH CAROLINA COPPER AND GOLD CO.

The North Carolina Copper and Gold Mining Company, of Rough and Ready, had three tons of their rock crushed at the Gold Hill Mill on Saturday last, which yielded a fraction over *four hundred dollars per ton!* The rock was hauled to the mill without picking, just as it came from the vein, and was taken out from about six feet in length of the tunnel. We question whether the same amount of gold was ever before obtained, from the like amount of rock taken continuously from any vein. We were informed yesterday that the Company are still taking out rock equally rich with that which they have just crushed. The lead is situated in Rough and Ready Township, about one mile south of the village, near Squirrel Creek.

Its existence has been known for some time, but no determined effort towards its development has been made until within a few weeks, when parties, whose names are given below, ran a short cross-cut, and struck a vein at the depth of 12 or 15 feet below the surface. From this point of intersection they have now driven along the line of the vein for the distance of 50 feet; the lead becoming gradually richer as they advance. It is the intention of the Company to run this tunnel about 2000 feet, which will give them on an average 250 feet of ground. A little reflection will show the experienced reader, that if the vein continues productive, the Company will then have an immense mass of work opened up to them, which will require many years to exhaust, before it will be necessary to strike a pick below the water level.

The ore, independent of the gold which is visible to the eye, presents the most favorable characteristics, much resembling the famous Lafayette lead in this place. The vein thus far, appears well defined, presenting clearly developed walls, and is 15 to 18 inches thick; the surrounding country is of talcose slate, gradually passing into the green-stone, which, in this vicinity, is considered a highly favorable circumstance. The expense of the present workings is more than paid by the specimens which are culled from the mass of ore. "Pockets," lined with beautiful crystals of various minerals, are occasionally struck, which are remarkably rich. One of these pockets which was opened the past week, yielded from two pans full of decomposed quartz, upwards of $100! The Company has now at the mouth of their tunnel about 20 tons of good ore, and are taking out about one and a half tons a day, by merely running their tunnel. They are now negotiating for the erection of machinery.—*Telegraph.*

GRASS VALLEY MINES.

We stated a few weeks since, that about 150 Quartz veins had been discovered and taken up within the precints of Grass Valley. Mr. Delano (Old Block), the present Recorder of Claims, has since carefully examined the records of his office, and reports 226 different quartz veins recorded, and 1948 Placer claims. Hundreds of both descriptions no doubt remain yet to be discovered.—*Telegraph.*

SHIPMENTS OF GOLD FROM SAN FRANCISCO.

The shipments of gold from San Francisco to London for nine months had been:

Total in nine months, in 1855	$3,606,987 28
Shipped same time in 1854	2,729,255 26
Shipped same time in 1853	4,562,850 62

To Panama the shipments were $188,207 in the same time.

To China, gold bars	$324,600
do coin	201,193
Total to China	$525,793
To East Indies, coin	111,889
To South America, coin	41,710
To Islands in Pacific, coin	41.717
To Australia, coin	6,000
Total shipments for nine months in sailing vessels	$727,109

Total Shipment of Gold Dust in Bars and Coin.

Per steamer in nine months	$31,697,631 82
Per sailing vessels in nine months	324,600 00
Total shipments by both	$32,022,231 82
Add total shipments of coin	392,509 00
Treasure of all kinds shipped in 1855	$32,414,740 82
Shipment same time (9 months) 1854	37,506,154 17
Decrease this year	$5,091,413 55
At $32,414,740 82 for the first nine months the shipments for the whole year of 1855 would be	43,219,654 42
The amount shipped in 1854 was	51,506,132 00
The amount shipped in 1853 was	58,906,956 00
The amount shipped in 1852 was	45,779,000 00
The amount shipped in 1851 was	34,492,000 00
Total gold exported in 5 years	$229,903,742 42

QUARTZ MINING AND ITS PROSPECTS.

The first experience in Quartz Mining is somewhat similar everywhere. The truthfulness of the annexed remarks by Mr. Joseph Rudy of Grass Valley, California, on the subject, will be admitted in some points by many of our readers in the Atlantic States. They present also a very favorable prospect for the future in that particular locality:—

Having spent a considerable time, for the past three months, in examining the districts of Grass Valley and Rough and Ready, I have thought it might not be uninteresting to some of your readers to learn the result of my observations. That the districts above mentioned abound in quartz veins, many of which are exceedingly rich in gold, even at their very out-croppings, is sufficiently evident to the most skeptical; and that they will, in most cases, continue to improve as they descend, is also abundantly proved by explorations already made. Up to the present time, the above named districts, and, indeed, I may venture to say, the entire State of California, has been merely scratched, so far as regards its rich deposits of gold; and a finer field for investment is rarely presented. Large and regular veins of gold-bearing quartz can be traced at the surface to almost any extent, imbedded in a beautiful stratum of ground composed of slate and granite, showing plainly in places, the junction of the two, which is usually considered a good indication. With such veins, and with the facilities now at hand for working them, I can advise, with a considerable degree of satisfaction, capitalists to turn their attention

more or less to the prosecution of the same. The business of quartz mining is a matter of vital interest to this county and State, and if properly managed, by practical men, and carried on by companies in a legitimate manner, it will be found an investment of the first order. As a proof of this it is only necessary to look at those working with little or no capital, who have to pay the highest price for raising their ores, for hauling them to the mill, for stamping, &c., leaving also considerable gold behind them in their sands, likewise working to great disadvantage from the want of means to lay open the veins properly; and yet, with all these disadvantages, many, I know, are doing a good business. Many of these same persons, had they been in a condition to have carried on their business in a proper manner, would, ere this, no doubt have realized comfortable fortunes.

Yet, with all these promising indications, quite too little is thought of that which must, sooner or later, be the principal source whence California must derive her supplies of gold, viz., her quartz veins. But this indifference, after all, is not to be so much wondered at. In the old countries the same ideas and the same method of working formerly prevailed. Most of the veins were opened a little on the surface, a shaft perhaps sunk to the depth of 20 or 30 feet, when the adventurers, in case they failed to find anything to make their exploration profitable, would look upon it as a bad speculation, and abandon it. By and by some other party would come along, sink the same shafts a little deeper, and in their turn abandon them to the next comer, to be resumed and re-resumed, until valuable deposits were found, which in many instances have continued paying richly until the present day, and at depths varying from a few hundred to 2000 feet.

The question is often asked, "Why has there been so much capital lost in the business in California?" In answer, I would say that it is owing in part to the high price of wages, materials, &c., that ruled at the outset; also, in a great measure to the want of practical men to develope the mines and properly carry on the business. In a great majority of instances, perhaps in five cases out of six, where large companies have been formed, some interested party have a relation or friend to introduce, as Superintendent or Captain at the mine. One, perhaps, who may possess a little theoretical knowledge of the business, but who never had the experience of breaking a single foot of ground for mining purposes; one, perhaps, who understood nothing of the true indications for making improvements, or the best mode of working his ground to advantage—one, perhaps, who is even ignorant of the quantity of work a man is capable of doing per day. Consequently, the Company loses the advantages of those great desideratums in mining, when such agents are employed.

No one discovers the lack of the requisite qualifications of a mining Superintendent sooner than the working miners themselves. They will soon perceive his lack of judgment, and, of course, he is sure to be duped by them and laughed at for his ignorance. It is in a great measure owing to losses incurred under such circumstances that capitalists are deterred from embarking more generally in mining operations, which, if properly managed, would afford remunerative returns.

In conclusion, I would say that practical men are the only persons fitted to carry on the working department of a mine, or who *can* do so economically, or in such a manner as to give the adventurers a fair return for their outlay. Facts speak for themselves, and this assertion I know will be corroborated by every individual who knows the difference between practice and theory.

My advice to those engaging in this department of industry is to select for their agents men who have gone through the entire alphabet of mining. With such men for your agents, success will most assuredly crown your efforts, and will place California in the first rank as a mining country.

EXPERIENCE IN GOLD MINING.

North Carolina, Ashe Co., December 10th, 1855.

Stephen G. Leeds, Esq.

Dear Sir:—Your offer in the pages of the Mining Magazine of November, induces me to address you on the subject of gold mining. Your remarks on this subject are so much to the point, and so entirely conform to my views concerning it, that it will afford me very much pleasure to correspond with you concerning it. The principle that the knowledge of this branch of mining should be free to all interested in it, I surely agree to, as a large portion of my knowledge of it, gained during the last four years, I owe to the experience of other practical men engaged in the business. It may be not uninteresting to you to hear the history of the mine, on which I am at present engaged, as it surely teaches a lesson to all, who may hereafter engage in working gold mines on a large scale; still your remarks on slow washing show you to be on the right way already, without such a lesson. This Gold Mine was worked successfully several years before the present owners came in possession of it, by a horse-power and a Chilian mill, with the Sullivan bowls as saving machinery; the rock containing gold, being soft (decomposed); in some depth below the surface, it became harder, and more power was needed for crushing. About two years ago a company of New York men took hold of it, and put up a large engine, a set of 12 stamps, and 2 large Berdan mills. The calculation made was the usual; the old mill yielded $5,00 per ton; we intend grinding 70 tons per day, with a yield of $200,00; the expenses will amount to about 40 per cent., giving a net gain of $8000 per month, paying at least 10 per cent. on the capital stock of $800,000 per annum. This calculation, however, proved fallacious, as all of the machinery, Berdan mills as well as stamps, proved failures. I never could do any thing more than pay expenses up to this time, as our ore does not yield more than averaging 15 to 20 cents per bushel. The Berdan mill yielded considerably more gold per bushel than the stamps, but, owing to its mechanical imperfections, it was a perfect nuisance, and I stopped it after several unsuccessful attempts to bring it aright. The stamps then remained the only chance, as the funds could not be supplied for erecting Chilian mills, which, I by-the-by, had advised before any selection of other machinery was made by men who thought themselves more competent judges of gold mining machinery. The sand from the stamps, I made arrangements to be spread over a surface of blankets, of about 6 by 8 ft., with an inclination of about 3 in. to the foot; after leaving the blankets, it was conducted to a set of 6 shaking tables, each 8 feet long, by 12 in. wide, with 6 riffles. The machinery for these not being constructed sufficiently strong, I soon threw them aside also, and am now using only blankets. The sand which collects on them is fed into one of Berdan's amalgamators, and a rocker. The stamps do not yield more than 18 cents per bushel out of ore, from which the Chilian mill actually yielded 32 cents per bushel. The reason for this I sought at first in the fact that the stamps produced very coarse sand, and I tried, therefore, very fine grates; but instead of the yield increasing, it diminished, owing probably to the fact that every particle of coarse gold, which the ore may contain, was ground so fine, that the water kept it suspended, and floated it off. I have obtained as high as 38 cents per bushel, of good ore, ground on the stamps. After my different experiments with the stamps, I have come to the conclusion, that this kind of machinery is not at all adapted to the working of any gold ore, except such as contains only coarse gold. According to former experience, I must be of the opinion that for any ore containing fine gold, no machinery, which I am acquainted with, is more adapted than the Chilian mill, with one upright stone running close to the shaft, the inner side of the runner describing a circle of about 13 or 14 in. diam. These mills agitate the water in the tub, not as much as the double-runner mills, which describe an inner circle of about 2 ft. diam.; besides that the

first have with the crushing a rubbing or squeezing action, which is of importance in preparing the particles of gold for amalgamation; the arrastra may for some ores be unnecessary, when the Chilian mill is well constructed.

You have no doubt paid close attention to the process of grinding down in the Chilian mill; did you ever try to diminish the quantity of water considerably during this process or stop it entirely? Those few experiments which I had occasion to make, gave astonishing results. I cannot find in this moment the notes made concerning the experiments, and if you think it worth your while to correspond with me, I shall have occasion to state the facts hereafter. It is common, on almost all the gold mines which I have visited, to let the same amount of water into the mill during the "grinding down the bed," as during the preparing of the bed; the consequence of it is, that a large part of the gold is thrown out of the Chilian mill, which will be only partly saved by the machinery below, a part actually floating off. You would oblige me by stating your experience concerning this point. You have also experimented with the rocker, and I should be glad to know from you, how you would construct a good rocker.

I shall stop here for this time, and I hope you will let me know what you think of the views contained in these lines; what I do know of gold mining, little as it is, is at your disposal, if it can be of any use to you or anybody else, provided you will give in return your views on the subject.

Very respectfully yours, &c., P.

CALIFORNIA AND AUSTRALIA.

"The Growth and Commercial Progress of the two Pacific States, California and Australia," formed the subject of an important and interesting paper, read before the British Association, at Glasgow, by Mr. P. L. Simmonds. The history of the gold fields of another hemisphere, their influences, both present and prospective, and the variety of aspects in which they have been viewed, have been repeatedly presented to the public; but Mr. Simmonds's known connection with the press as the City Correspondent of the *Globe*, and the attention he has devoted to statistical and commercial inquiries, entitle this elaborate essay to peculiar notice, and we are glad to be enabled to make the following abstract. The fabled El Dorado, so long sought by the Spaniards, has been more than realized in the veritable gold regions of our days, which in the brief space of about seven years, have added an aggregate value of nearly 180,000,000*l.* sterling to the gold previously in circulation. The circulation of this accumulated wealth is, perhaps, the smallest portion of the benefit which the nations of the earth are likely to derive from its discovery, when compared to the stimulus it must impart to commercial enterprise, the new fields of industry it must open for honest labor, the profitable marts it must unfold for British and foreign merchandise, and the scientific and practical improvements it must introduce in ocean steam navigation. The startling discovery of the vast metallic and mineral wealth of California attracted to its shores in the space of 12 months, in 1849, more than 100,000 people, 80,000 of whom were Americans; and an extensive commerce has since sprung into existence at San Francisco with China, the ports of Mexico, and the islands in the Pacific, Chili and Australia. At the close of 1853 the population of California was estimated at 328,000 persons, the value of the imports at 7,000,000*l.*, or 20*l.* per head; while the export of gold amounted to 12,000,000*l.*, or 34*l.* per head, exclusive of quicksilver and other produce. At the period of the discovery of gold in California, there were in the United States coin and specie to the value of 20,000,000*l.* sterling, while in 1854 the amount of specie in the banks and in circulation had increased to nearly 50,000,000*l.* sterling, exclusive of a heavy drain of specie to Europe, amounting in the last four years to 27,500,000*l.* A leading mercantile firm at San Francisco (Messrs. Hussey, Bond, and Hale) made some elaborate calculations of the gold produce of

California up to 1853, which resulted in the following figures:—Gold deposited in the United States mints up to the close of 1853, $219,145,000; gold circulating in California and Oregon, by careful estimates, $19,000,000; 8 per cent. of the amount estimated to have been taken to other countries, $39,400,000; 5 per cent. estimated for gold used in manufacturing articles or otherwise, $10,950,000; giving the total product, $288,495,000, equal to 57,700,000*l.* British sterling. The *San Francisco Herald* gives the following as the ascertained shipments of gold in the last four years, exclusive of the large sums transmitted through private sources:—1851, $34,492,000; 1852, $45,779,000; 1853, $54,906,956; 1854, $51,506,182;—total in the four years, $186,684,088, equal to 37,337,000*l.* sterling. There was also coined at the San Francisco Mint last year, gold of the value of $9,731,574, adding nearly 2,000,000*l.* sterling more to the gold production of the State.

The shipments of gold from San Francisco in the first six months of 1855 were to the value of about 4,000,000*l.*, against 5,000,000*l.* in the first six months of last year, but this is no proof of any falling off in the yield of the gold fields. Gold finds its way from the State through a variety of channels; much, however, is lodged in the banks, and even buried in the ground for safety; but making all due allowances, the mean of the various estimates gives fully 71,200,000*l.* sterling as the total yield of gold from California from its first discovery to June, 1855. One of the influences of gold in California has been already to plant a powerful and thriving commercial state on the Pacific, destined to work a singular revolution along the shores of the Eastern Archipelago and of Asia. It has already congregated together thousands of thrifty and plodding colonists, opened a trade with the hitherto sealed empire of Japan; and while it daily spreads the wings of commerce over the Pacific towards the extensive shores bounded by that ocean, it is also drawing an overland traffic over heretofore untraversed continents. It has led to the construction of a railway across the Isthmus of Panama, thus uniting the increased commerce of both oceans, and must speedily open up fresh channels of communication by steam with this country, with Europe, and the world at large.

Crossing the Pacific, we next briefly observe what gold has effected for Australia, and we regret that our limits prevent us from following Mr. Simmonds through his elaborate and valuable details, and oblige us to confine ourselves to the gold produce alone. The estimated population of the various gold fields of Victoria on the 19th of August, 1854 was given at 111,735 persons, of whom 77,500 were men, 16,555 women, and 17,680 children; about one-third of them were engaged in the search for gold. The gold produce of Victoria, taking the estimated value, for simplicity of calculation, at 4*l.* per oz., was for last year, in round numbers, 2¼ ozs. per head, which would give to each of those 77,500 men at the diggings about 113*l.* per annum. Of course, many received larger sums, but the average was, consequently, less. The estimated value of gold, the produce of the gold fields of Victoria, up to June, 1855, would appear to be 44,143,384*l.* The gold brought in by escort to Melbourne was, in 1853, 1,964,153 ozs.; in 1854, 1,738,098 ozs. A Bluebook, recently published, gives the quantity of gold exported from Sydney up to June, 1854, at 1,661,355 ozs., which, at 4*l.* the oz., would be worth 6,645,420*l.*, but was only there estimated at 5,399,350*l.*, the colonial price. The net quantity of gold exported from the two colonies, Victoria and New South Wales, between the 29th of May, 1851, and the 30th September, 1854, was estimated at 7,866,509 ozs., valued at 27,975,419*l.*, while the true value would be about 31,546,036*l.* Last year the banks doing business in the colony held a stock of coin and bullion exceeding 2,500,000*l.*, deposits of about 5,000,000*l.*, paid-up capital of 3,000,000*l.*, and had divided profits ranging from 8 up to 40 per cent. per annum. The gold diggings of New South Wales, although less prolific than those of Australia, according to a careful comparison which Mr. Simmonds had made, returned nearly 170*l.* as the year's earnings for each digger in 1853. As the average produce for the number of men employed was 42¼ ozs. 250*l.* each would be nearer the mark; and some of the colonists

assume 78 ozs. as the average find per head, which would give nearly 300*l.* The total gold exported from Sydney up to the close of 1853 amounted to 1,625,256 ozs., but some of this had been brought from the Victoria gold fields, and it is difficult to distinguish the separate produce. The value of the gold shipped from Sydney up to March, 1855, was nearly 7,600,000*l.* The total value of gold which must have reached Adelaide from the Victoria gold fields amounted to nearly 3,250,000*l.*, and at the London price of 4*l.* the ounce for Victoria gold, the value would be enhanced fully another quarter of a million.

This colony is rich in other valuable mineral produce, requiring but steady labor to bring it to the surface. There are now 49 reported mines in South Australia—seven lead, two silver-lead, one gold field, and the rest copper. Only seven, however, of those mines were in operation at the close of the last year, mainly in consequence of a deficiency of available skilled mining labor. In the six years ending with 1850 the metalliferous deposits of the province had yielded 115,520 tons of copper ore, worth, at 15*l.* per ton, 1,732,800*l.*; and 2429 tons of silver-lead ore, worth, at 12*l.* per ton, 29,148*l.* One of those Pacific States, the advance of which was thus illustrated—viz., California—had been entirely founded by the gold discoveries; while the other, although colonized some time previous, also owes its remarkable commercial advancement to its prolific gold fields; and the contiguous island and continental settlements of Australia have shared more or less in the wonderful prosperity of Victoria. Within the last seven years a population of about 330,000 has settled in California, and the result of their labors has been a gold produce of 71,200,000*l.* In the last four years an addition has been made to the population of Victoria and New South Wales of about 250,000 persons, and the gold they have obtained has amounted to 51,662,794*l.* Amongst the most prominent benefits which the gold discoveries have conferred upon Australia, we may record that they have led to the cessation of transportation to Van Diemen's Land, to the separation of Victoria from New South Wales, to free institutions and independent government for the colonies at the Antipodes. Gold has enormously increased the revenues of those colonies, and enabled them to place large sums in the hands of the Emigration Commissioners to promote bounty emigration, by the dispatch of several shiploads every month, besides swelling the tide of private emigration.—*London Mining Journal.*

AUSTRALIAN GOLD FIELDS.

The half-yearly gold accounts bear out the anticipations as to the increased production of the auriferous districts. Take the following statement for the three months ending June 30, in 1854 and 1855 as evidence of this:—

	1854.	1855.
By escorts—April	182,807 ozs.	177,745 ozs.
" May	143,618 ozs.	120,198 ozs.
" June	125,078 ozs.	227,315 ozs.
Total	451,503 ozs.	525,258 ozs.

Increase on the quarter 73,750 ozs., which will increase the purchasing power about 1,180,000*l* this year. The quantity of gold exported is—

In 1854—Six months	1,182,810 ozs.
In 1855—Six months	1,077,431 ozs.
Difference	105,379ozs.

JOURNAL OF COPPER MINING OPERATIONS.

LAKE SUPERIOR REGION.

Isle Royale Mining Co.—The directors of this Company, have issued a circular to the stockholders, from which we make the following extract.—It presents a very favorable prospect:—

At the close of another navigation-season, your Directors think it due to themselves and to you, to present a brief account of the year's operations, and of the present position of the Mine and the Company. With these objects in view, they directed the Treasurer to proceed to the Mine, in the latter part of October, to obtain the latest and most thorough intelligence of its condition, by personal examination, and from the views of the efficient Superintendent. It is gratifying to be able to state that the reports of both officers were favorable. Without entering into details, it is sufficient to say that both regard the Mine as looking *better, upon the whole*, than it did in the early part of the summer, although it has since yielded 150 tons of rough copper.

The Superintendent writes to the Directors, under date of Nov. 5th, "Since the first of June last, there have been removed by stoping, as appears from our mine-book, $252\frac{6}{216}$ cubic fathoms, leaving still untouched, as per estimate, $2715\frac{22}{216}$ cubic fathoms. This shows that a small amount of ground has been removed this summer, *and it must be folly indeed* to suppose that this small amount is all the rich ground of the "Isle Royale Mine."

The estimate of ground ready for stoping, gives to the vein an average width of 9 feet. The vein, as is well known, is somewhat variable in width, —"in some portions of the mine," says the superintendent, "it has been removed for *twenty-seven feet* in width."

In brief, the Directors have every reason to believe that the yield of the mine in 1856, will be considerably larger than it has been in 1855. Since the opening of navigation, there have been shipped from the mine, about 250 tons of rough copper, averaging above 65 per cent. of pure metal. Of this quantity, 41 tons are yet unsmelted, but are in hand or are on the way. About one third of the copper smelted, has already been sold, but the whole stands charged on the Company's books to the smelting and selling agents, the Revere Copper Company of Boston. Estimating that the unsmelted copper will yield the average of previous shipments, the total yield of the year is shown to be 314,941 lbs. of pure copper, worth, at the market price of 28 cents per lb.—$88,183, or $82,233 after deducting the smelting charges and commissions. The following is the exact financial condition of the Company at the date of the circular.

Assets.

Copper on hand and on the way and charged to Revere Copper Co. as above specified, - - - - - - - -	$82,233	
Less advances made by the Revere Copper Co. - - - -	38,000	
		44,233
Notes receivable amply secured, - - - - - -		750
400 shares Isle Royale Stock, at $13, - - - - -		5,200
Six months' supplies at the Mine - - - - - -		10,000
Total Assets, independent of Mine machinery, buildings, wood, tools, &c. &c. - - - - - - -		$60,183

Liabilities.

Due at the mine Dec. 1, after deducting Cash, in hands of Superintendent, - - - - - - - - -	$2,000	
Outstanding Drafts of former Superintendent, - - - -	2,700	
Outstanding Drafts of present Superintendent, - - - -	2,677	
Balance due Douglass & Sheldon ($3,800 being for supplies purchased of them), - - - - - - - -	6,000	
Notes Payable, - - - - - - -	17,139	
Total Liabilities, - - - - - - - -		$30,516
December 1, 1855, Balance of Assets over Liabilities, - -		$29,667

The Directors would remark that "the supplies at the mine" are, practically speaking, as good as CASH. They are furnished to the miners through the winter, at fair prices, and the sum due in the spring will be lessened by the value of the supplies consumed. The Company merely advances the money for a short time. This explanation may seem unnecessary to many, but the Directors have reason to believe that the subject of "supplies" is not understood by all. By the foregoing figures it appears that when the copper on hand is sold (and as the price is advancing, there is no necessity of forcing a sale) the Company will have a clear surplus of about $80,000, *after paying every cent it owes.*

With reference to the question of gain or loss in the year's operations, the Directors can only furnish a statement, approximate to the truth. The present system of accounts was not adopted until the first of June last, and they prefer not to go behind that date. Since that time the outlays have been necessarily heavy, for various reasons. In June, 1856, however, the Directors hope to be able to inform the stockholders, fully, of the cost of operating their mine. Estimating, in the mean time, the mining expenditures of October and November, as equal to those of September, and deducting the supplies on hand, purchased in the summer and early autumn, there appears to have been a total expenditure of $29,730 28, in the six months ending Dec. 1, 1855. In the same period, the mine has yielded 150 tons of rough copper, worth about $50,000 net, to the Company in Boston. The Directors do not pretend to assert the exact correctness of this statement. It is near enough, however, to prove that the Isle Royale Mine has more than "paid its way" since June 1, 1855. And with a mine and machinery in good order, and system and economy in its management, there is reason to believe that the cost of mining will not increase in nearly so rapid a ratio, as the product of metal.

The Directors would observe, also, that since June, but 16 heads of stamps have been in operation for any length of time, and that even these have been interrupted for a considerable period, on account of necessary changes and improvements in the machinery. The entire force of 32 heads is now in full operation.

In conclusion, the Directors would express their firm conviction that every thing is going well with the Isle Royale Company and its mine, and that the Stockholders have not only passed the point of "Assessments," but are coming within hail, at least, of fair dividends.

"ILL-TIMED AND ERRONEOUS STATEMENT."

The papers of the Lake Superior region take exceptions to a remark of ours, respecting the stock of the Norwich and Windsor Mining Companies, which appeared in the September number of this magazine. At the time our remark was written, about September 1st, the American Mining Co. was closing up its affairs, and the present organizations of the Norwich and Windsor Companies were hardly known. At that moment all the stocks of the mother company were looked upon with distrust; but the Norwich and Windsor soon passed into the hands of new and distinct organizations, and with the well known value of their property, immediately secured the confidence of the public. These particulars have been stated in these pages, subsequently to September 1st. We think that with these explanations, our friends must perceive, that if our remark had been made at a later date than it really was, their exceptions, in consequence of the change of circumstances relative to the Norwich, &c. mine, would have been well taken.

THE MINES.

For the following particulars respecting the present operations of many of

many of the mines, on the shores of Lake Superior, we are indebted chiefly to the *Ontonagon Miner*.

Nebraska Mine.—The Nebraska Mine continues rapidly to improve. The adit level is now in, at base of hill 245 feet. The rock has become settled and the vein very regular. On the last 100 feet the course of the vein is direct, which is a little south of north-east. Its walls are both regular, and its width 4 to 5 feet. Its product is mass and heavy barrel and stamp-work—masses from 800 to 1200 pounds. It is now looking better than at any previous period. From one to two tons of masses are yet unremoved in the last 8 feet of the adit, and the lode is making still stronger.

On the top of the hill, on another vein, an "ancient pit" has been cleaned out nine feet in depth, and a shaft sunk thirteen feet. This vein underlies *that* opened by the adit about 150 feet. It is defined by regular walls, and is from four to five feet wide. 1200 pounds of heavy barrel copper have been taken from it in the depth sunk.

Underlying this vein at respectively 100 and 200 feet are two other veins. Each of these, and *that* which they underlie are marked by frequent and very extensive "ancient pits," crossing parallel the entire length of the location.—All of the pits that have been cleaned out show distinct veins, and mass and lump copper.

Parallel to and underlying, still, these veins, at about 150 feet, is the vein resting upon the conglomerate belt, upon which the company has commenced a shaft, with very encouraging results.

The copper shipped by this mine and awaiting shipment this month, will amount to thirty-five tons.

We understand that the workings at the What-Cheer Mine are resulting very favorably. This is a new Company which has been at work but a few months. Their mine lies between the Douglass Houghton and the Indiana Mines.—They have opened and are sinking upon two large and very promising veins, and are taking out good barrel and stamp copper quite at the surface. Such early results must be gratifying to those in interest. This company have a half section of mining land.

A contract has been made for opening the newly discovered vein on the Johnson Pre-emption, on terms extremely favorable to the owner of the location.

The contractor is to sink ten fathoms and drive fifty feet one way, and one hundred and fifty the other, on the course of the vein; for which he is to receive at the smelting works one-third of the ingot copper made from the mass and barrel work, which he takes out of the shaft and drift in opening. He is not allowed to stope at all, nor to follow any mass beyond the regular boundary of the shaft or level. This contract certainly exhibits great confidence in the richness of the ground.—Though it must be recollected that he starts with several tons in sight.

We learn that the Shawmut Mining Company have suspended operations for the present.

The Forest, Windsor, Toltec, Trap Rock, the Gogebic, and several other Mines of this district will increase their force, as fast as they can procure the miners, so that we may expect quite an increase in the amount of copper to be raised during the coming over the production of the past winter.

At the Adventure Mine we are informed by their clerk, they have a mass not fully uncovered, which is estimated to weigh three tons.

We are also informed that the Aztec Mine raised in 5 weeks about 4½ tons of copper with 6 miners.

We learn by rumor that Smelting Works are in course of erection in the city of Chicago. It is also stated that much of the stock of the Central Company is passing into Chicago hands.

We are pleased to learn that a company, organized some time since under the laws of Wisconsin, are really going into active operation about nine miles

south of the bay and city of Superior. Their location is about nine miles off the Nemadji river, being N. E. quarter section 8, Town 47, N. Range 13 W. Mer. Wisconsin. Their veins, of which there are two, run parallel to the bluff, along the northern crest, and dip to the south, probably about 40°. The crown of the bluff is about N. E. and S. W. The vein stone in the north lode is Chlorite and Epidote. They will commence by sinking a shaft on each vein, working a small force during the winter.

The result of their operation will be looked for with much interest, as it is the first attempt at mining in that region. Mr. W. G. Cowell, formerly of Mica Bay, has been appointed superintendent. They bear the name of the Fond du Lac Mining Company.

The Norwich have struck a branch or feeder on the adit level, about 20 feet east of shaft No. 5, which leads off from the vein at a considerable angle to the south. It has been opened for six or eight feet, and is found to be a very rich lode, from 6 to 14 inches thick, containing beautiful crystalline copper, and a promise of much mass.

The Windsor have completed their kiln house and one of their kilns. The stamp house is enclosed; the masonry is progressing, and will be ready for the engine and machinery before the cold weather sets in. They cannot get the engine in the mine until the snow falls, and the road has become settled, but expect to get the stamps in full operation by February next. Not more than twelve head will be set up this winter, though they have room and power for 24 head. A large amount of stuff is awaiting this event, already burned—sufficient, it is thought, to produce 20 or 30 tons of copper. They have raised of mass and barrel about 40 tons this year.

The stamp house is located on the Ontonagon, and reached by a railroad about 1,900 feet in length from mouth of adit. This has been in use ever since the holeing of the adit in August last, but they have lately laid it with iron throughout.

The adit is a very fine sample of mining. It is about 600 feet in length; was holed in August last, having been 20 months in driving.—It strikes the vein on the most eastern shaft, (No. 1,) at about 42 fathoms from surface, thus leaving a back of four lifts—ground enough for a tolerable mine above the adit level.

Their stopings have been entirely to the west of this, some three or four hundred feet.

Drifts have been made some 140 feet to east and west of the adit, but the ground has not proved very rich. In about two or three months' driving west from No. 2 shaft they will in all probability strike the course of copper met with in the second level.

It is their intention to increase their force to about 100 men during the winter.

During the past season important accessions have been made to the machinery employed in the Ontonagon district. The Windsor, Forest, Minesota, Rockland, Ridge and Toltec mines have each a new engine to their machinery. —Two steam saw-mills have been erected, one up the Middle Branch, by McGregor, and one at the Minesota Landing, by Peck & Cavana. A new water mill has, also, been built at the Nebraska. Additions have been made to the machinery at Greenfield's lumbering establishment. A new mill is in course of erection in this village, and the engine is daily expected. This will make four new saw-mills more than we had last year, and adds *nine* new and one repaired engines to the machinery of the district. Several of these are excellent machines of great power.

We learn that the Evergreen Bluff has in the last week or two thrown down some two tons of mass copper.

We learn from reliable authority that the Central Mine will have shipped the present season over 53 tons of rough Copper, which will yield very richly, as there are only 19 bbls. in the entire lot. We stated the yield of this mine some time since at 75 tons, but our informant was misinformed.

The North Western will reduce their force about one half during the winter.

During the week we visited the mines of the Ontonagon District which lie to the east of the *Ridge;* including the *Adventure*, *Evergreen Bluff*, *Merchants*, *Toltec*, *Aztec*, *Fire Steel*, *What Cheer* and *Douglass Houghton*.—We also passed over the location and took a rapid glance at the works of the following mines lying on our route, which are for the present suspended, viz.: the *Ohio*, *Bohemian*, *Indiana* and *Algomah*.

At the *Toltec*, the railroad to the stamp house is about completed. For want of this their stamp mills have been stopped for some two months past, which will affect very sensibly their shipments of copper during the season. This could not be avoided without building a wagon road, which could not have been of any use after the completion of the railway. The track is a substantial and well built affair. We think a little change of location would have enabled them to avoid once handling the vein-stone, which is rendered necessary by the present track. But this will not be a serious difficulty. The engine house to receive the machine for hoisting and pumping is raised, and the engine may be ready for work in five or six weeks. The mine is much filled with rock and vein stone which is awaiting this event. It does not therefore show to very good advantage, particularly as they happen at the present time to be in ground that is not as rich as their usual vein. They are pushing on their operations—sinking shafts 2 and 3, and driving on 3d level to east and west; also connecting with the winze between shafts 2 and 3.

They seem to be preparing for heavy operations this winter. And with their beautiful surface improvements, their new hoisting engine and splendid stamp mill—working upon a vein of well known richness—they are certainly prepared to get out a large amount of copper during the coming year.

Adventure Mine.—The Adventure folks are still getting out copper wonderfully, considering their plan of mining, if their present operations are worthy of that name. The old regular openings upon which so much money was spent in search of a true vein, are pretty much abandoned. Parties are stoping a little in the adit driven several years since, by Esq. Moyle; but besides this, they are merely burrowing in holes on the east of the bluff, where a great number of outcrops of copper occur. In almost every instance they have gone to work in the pits made by the ancient miners. Some 50 or 60 men are at work in this way on tribute, and are getting out a great amount of copper. In the most of these holes there appears abundance of mineral, and we noticed one mass of 2 or 3 tons' weight.—There are plenty of small masses and barrel work.

It is altogether probable that this hill is full of beds and irregular deposits of copper, and the man that will teach us how to get it out with sure profit, will indeed be a public benefactor. Under the circumstances their present plan of operations is probably the most judicious. The company are tired of searching for regularity in their veins, and it may be as well to let the miners go on in their own way and prove the great richness of the surface outcrop.

They have just finished a little stamp mill of four heads, driven by water.

At the *Evergreen Bluff* they are working two stoping parties and one in driving the adit. They have quite a large mass in sight at one place.

The *Merchants* are merely driving an adit to cut a course of copper which outcrops near their ground on the Adventure location. They struck quite a mass lately, but it is doubtful whether they have yet reached that for which they were driving.

The *Aztec* Mine is now worked very much as the Adventure. Several parties are extending ancient pits in the very crest of the bluff, and taking out, on tribute, an amount of copper that is truly surprising. The old adit and shaft are entirely abandoned. There are but few men at work, and they have, we understand, the right to go on in this way for six months. They

have now some ten or twelve tons of copper on hand, and have probably earned from $75 to $150 per month since they commenced.

The Fire Steel.—This mine lies three or four miles to the east of the Toltec. We regretted that we were not able, for want of time, to go underground. Their openings are about as follows: they have sunk one shaft to 2d level, have driven an adit 280 feet to the vein—driven to east and west, on 1st level 260 feet, and on 2d level 160 feet. A trifling amount of stoping has also been done, to prove the lode. The vein-stone certainly looks quite promising in barrel and stamp work; though they have not as yet found large masses.

The *What Cheer* are working on what is thought to be the Douglass Houghton vein. Have commenced we believe in three places. Have not as yet gone low enough to show the character of their ground, but have turned out some copper, in barrel and stamp work.

At the *Douglass Houghton*, they seem to be sinking to meet that peculiar conglomerate belt which underlies the vein at various points along the range, and which appears at the Norwich and Minesota locations. From the best data they have relating to the dip of that formation, it is thought they are very near to it. They have just commenced a cross cut in the lower level, which ought to strike it in about ten or twelve feet. Should they find masses hereafter, as they hope to do upon a lode overlaying the conglomerate, they will have a mine at once, for the present state of the work will enable them to extend their openings with great rapidity. There is already a large amount of vein-stone stripped and ready for taking down as soon as it is determined to put up machinery for working the mine. We thought we observed a singular constancy in the richness of the vein, in all its levels. With the aid of proper machinery for lifting and stamping, it will well repay them to work up a large amount of stuff which may at once be taken from their lode.

Toward the surface the vein is unquestionably much disturbed, being thrown by one fault and probably several slides. In the upper level the course of the drift is very tortuous, making, in places, angles as great as 40° or 50°. The lower openings, however, seem to improve in regularity.

The *Algomah* lies on the east of the Toltec, and unquestionably have the vein of that mine. After sinking four shafts and clearing off the vein at the foot of the bluff, to be ready for driving an adit, they suspended operations until the proving up of the Toltec vein.

From a rapid glance at the numerous diggings and surface show on the *Ohio* location, we are led to conclude that the value of the ground has not as yet been tested.

Bohemian.—This company have worked two locations in this district. Their last operations were closed about fifteen months ago. They had been working on the Piscataqua location in sec. 31 and 32, town 51 N., Range 37 W., under the direction of Mr. Dickerson, now of the *Isle Royale*. From the appearance of the vein-stone taken out, we think it altogether probable that this may yet make a mine at some future day. From the pile of stuff which lay on the premises we picked up and carried off a very clever silver specimen.

Indiana.—This mine is owned almost entirely by agents and mining men in the copper country. They have three good veins on the location—the Indiana, the Douglass Houghton and the Fire Steel. Operations have been long since suspended until better times.

The *Chicago* location lying in sect's 9 and 16, is a mistake of somebody's. We do not understand its history—but there is no surface evidence of mineral there. Indeed the tract is almost entirely flat, and covered with soil which has probably never been disturbed, and therefore affords no chance for an outcrop of any sort.

During the month of October the Minesota raised *one hundred and thirty-four* tons, and 1268 lbs. of copper. The Rockland during the same month raised about *fourteen* tons.

JOURNAL OF SILVER AND LEAD MINING OPERATIONS.

DUTCHESS COUNTY, N. Y. LEAD MINE.

NEW YORK, August 22, 1855.

E. H. Warner, Esq.,

Dear sir,—Agreeable to your request, I have examined a mining tract about eight miles west of Amenia, in Dutchess County, New York, and I hereby communicate to you my opinion in regard to its mineral resources.

The existence of lead ore on this property was known even at the time of the revolutionary war, when the veins were worked by order of the U. S. government, and the lead was carried to West Point for the use of the army. These workings, however, were of a very superficial nature; no mining skill appears to have been employed, and the veins were excavated as deep as it was convenient to throw the ore and gangue upon the surface. Within the last four years operations have at several times been renewed, but never prosecuted with that energy and confidence, based upon experience and knowledge, which alone can lead to satisfactory results, of a legitimate character, in mining enterprises.

The lead veins are found in a limestone belt, which has a bearing of N.E.N.—S.W.S., and is, within the limits of the Bryan farm, bounded N.W. by an upheaved slaty ridge, while at a distance of about a mile S.E. gneiss rock predominates. This belt appears to be penetrated at several points by numerous strings of lead ore, which show an average course of S. 60° E., have a nearly vertical inclination, and belong to the class of segregated veins. Near the surface they are seldom more than half an inch thick, and at the shallow depth, to which they have been explored, their thickness scarcely exceeds three inches (of solid ore); but they are continually increasing downwards, frequently joined by "droppers;" and as there are often also, but a small distance apart, several main strings dipping towards each other, it may, from comparison with similar localities, safely be inferred that by extending the work to a proper depth, say of 100 or 120 feet, several veins would be struck of a sufficient width and yield, to be worked to great advantage, if the unusually large percentage of silver, contained in these ores, be taken into consideration. In some places the galena is accompanied or substituted by grey copper ore, which has also been found rich in silver; I doubt, however, that this ore, in the same formation, will ever become predominant, though a vein of it would be no less valuable than a similar lead vein.

Two of the former workings, which are also the most extensive, may be considered of some service in future operations, viz., an adit level of about 80 feet and a shaft of about 35 feet. The adit level has been driven S. 5° W., at a depth of nearly 40 feet below the top of the belt, and was intended to cross-cut the veins; I would recommend its continuation, though in a more S.W. direction, as it is well calculated to answer the twofold purpose—first of removing the surface water, and second of opening the veins at a depth sufficient, at least, to allow an approximating estimation of their relative value, and furnish a guidance for the proper location of shafts and direction of lower workings, even if their appearance should not yet warrant a profitable extraction, though I believe that some of them would be found rich enough to cause graduation operations from this level, which would be attended by great facilities. The 35 feet shaft also would be extended to the depth above mentioned and cross-cuts driven from its bottom. Its location is pretty well adapted for a whim and pump shaft, and its present dimensions may suffice for this application.

* It should be stated that, since the above was written, copper pyrites, as well as also traces of galena, have been met with in the progress of exploration on this lode.

It has been suggested that the lead veins were probably confined to the limestone formation, which has ever been called "the metal-bearing rock," and that a change of "country" would terminate their existence. As far as the kind of ore is concerned, there is some reason in such a supposition, but in regard to the veins themselves, I have found no inducement yet to become an easy believer in the "running out" of veins, a theory which appears to be rather favored among miners and even some geologists in this country, although often contradicted by fully investigated and comprehended facts. In order to demonstrate, if possible, at least the doubtfulness of the above suggestion, I closely examined the bordering slate ridge, in the direction of the bearing of the lead veins, and soon discovered the indications of a lode, which, tracing to the top of the ridge (about 500 feet high), I there found the solid outcrops. These have since been opened by a cross trench and show a width of 25 or 30 feet. The only ore thus far met with is oxide of iron, which fills the crevices of the quartz and abounds in the contiguous slate. What kind of metal this lode may carry under its "iron hat," is as yet impossible to determine; the probability waves between hematile, spathose iron, and sulphuret of copper; but there can be no doubt as to its deserving a thorough exploration. About 50 rods N.E. from the cross trench, the outcrops of another parallel lode are also exposed.

Now, as far as I have been able to detect the courses of these lodes, they underrun the limestone belt just at those points where the lead veins are situated. Is it not probable then that there is some relation between these lodes and those lead veins?—that the latter are mere leaders to a champion lode in the underlaying slate formation? But however this may be, it would do no longer to term the limestone the metal bearing rock of this region.

In conclusion, I would say that there is no doubt in my mind but that this mining property, under a skillful and economical management, would richly remunerate the outlays necessary for its development.

I am, sir, respectfully yours,

AUGUST PARTZ.

MISCELLANIES.

ALLOYS OF IRON.

Amongst the papers submitted to the meeting in the department of Practical Science was an important one on some interesting alloys of iron and aluminium, by Professor F. CRACE-CALVERT, of Manchester. The experiments on the subject had been undertaken with the view of solving one of the great chemical and commercial questions of the day, namely—that of rendering iron less oxidable when exposed to a damp atmosphere, as it was believed that no kind of coating can be discovered which will resist the constant action and friction of water on iron steamers. Potassium was the most electro-positive metal hitherto known, and, as such, less liable to combine with oxygen; and, consequently, alloys of iron and potassium were remarkable for their hardness. Professor CRACE-CALVERT, however, in conjunction with M. RICHARD JOHNSON, had succeeded in producing two new alloys, composed of iron, combined with that most valuable and extraordinary metal, lately obtained by Mr. ST. CLAIRE DEVILLE, aluminium, to which we have repeatedly directed attention. These two alloys are composed as follows:—First, 1 equivalent of aluminium, 5 equivalents of iron; second, 2 equivalents of aluminium, 8 equivalents of iron; and the last alloy possessed the useful property of not oxidising when exposed to a damp atmosphere, although it contains 75 per cent. of iron. Messrs. CRACE-CALVERT and JOHNSON hoped to discover, before the association

next met, a practical method of preparing this valuable alloy, which would render essential service to arts and manufactures. The following alloys were also described:—One composed of 1 equivalent of aluminium, and 5 equivalents of copper; one other of iron and zinc, composed of 1 equivalent of iron, and 12 equivalents of zinc. This last alloy is not only interesting from its extreme hardness, but it is produced at a temperature of about 800°, being formed in a bath of zinc and iron, containing 14 tons of metal, through which iron wire is passed, when coated with zinc, or galvanised. These gentlemen had also prepared several alloys of zinc and copper; copper, zinc, and tin; and copper, zinc, tin, and lead, having definite and equivalent composition; but, as they hoped to enter more fully into the subject next year, they expected that the result of their researches would be that, by preparing commercial alloys according to fixed scientific rules, instead of mere routine, alloys would be produced for commerce far cheaper than those now in use. The action of acids on those alloys was stated to produce this curious fact,—that although hydrochloric acid violently affects zinc and tin in alloys containing those metals, with copper they are but very little affected by this powerful acid, and similar results with sulphuric and nitric acids.—*British Association.*

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